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RTO TECHNICAL REPORT TR-058 **SAS-028**

Cost Structure and Life Cycle Costs for Military Systems

(Structure de coûts et coût global des systèmes militaires)

This Technical Report has been prepared by the RTO Studies, Analysis and Simulation Panel Task Group SAS-028.

Published September 2003

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- SAS Studies, Analysis and Simulation Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

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Cost Structure and Life Cycle Costs for Military Systems

(RTO TR-058 / SAS-028)

Executive Summary

Life cycle cost (LCC) represents all the costs that will be borne during the life of a System (Main System and Support System) to acquire, operate, support it and eventually dispose of it. The list of costs items to be considered in a project is defined and organised in a Life Cycle Cost Breakdown Structure (LCCBS) also referred to as a cost breakdown structure (CBS).

Most nations have their own CBS that is used for national programs. In the same way, each national CBS refers to definitions that can be different from one country to another. The first aim of this study was to develop a generic cost breakdown structure (GCBS), common to all Nations, and an accompanying glossary of LCC terminology to support the GCBS.

In system analysis, a CBS may be considered as a tool that enables analysts to define and compute LCC and decision makers to take decisions. The way analysts and decision makers use LCC has necessarily an impact on its definition and thus on CBS. That is why this aspect has been taken into account in the study. This aspect includes the classification of costs into several categories (direct, indirect, variable, etc.), the definition of LCC variants (LCC, TOC, COO, WLC) and the use of each one.

The main results of the study consist of:

1. a Generic Cost Breakdown Structure and associated definitions that can be used by any military programme to construct its own CBS,
2. an analysis of the way to use LCC in the decision making process.

Definition of LCC and its uses in decision making process are not the sole aspects to be considered. Other issues concern for example methods and computational tools, data and databases. However important are these issues, they have not been included in the study that focused on life cycle cost rather than life cycle costing[1]. Those issues could be handled in the framework of a follow-up study.

The GCBS elaborate by the WG needs to be checked and experienced in national or multinational programs. This exercise concerns not only the CBS but also considerations dealing with the uses of LCC and the associated definitions (LCC, TOC, COO and WLC). The conclusion of this experimentation could lead to improve the results presented in this report.

[1] Life cycle costing is a set of techniques for modeling, predicting and analyzing the Life Cycle Cost of a system, at any stage of its life.

Structure de coûts et coût global des systèmes militaires

(RTO TR-058 / SAS-028)

Synthèse

Le Coût global d'un système est constitué de l'ensemble des coûts engendrés par le système (système principal et système de soutien) pendant son cycle de vie. Il inclue les coûts d'acquisition, d'utilisation et de retrait de service. La structure de coût global (SCG) permet de définir et d'organiser l'ensemble des rubriques de coûts à considérer dans un programme.

La plupart des nations ont leur propre SCG qui est employé pour des programmes nationaux. De la même manière, à chaque SCG nationale est associé en ensemble de définitions qui peut être différent d'un pays à l'autre. Le premier objectif de cette étude était de développer une structure générique de coût global (SGCG), commune à tous les pays, et de définir la terminologie associée.

Dans l'analyse des coûts d'un système, la SCG peut être considéré comme outil utilisé par les analystes pour définir et calculer le coût global qui est ensuite inclus dans le processus de décisions. La façon dont les analystes et les décideurs utilisent le coût global a nécessairement un impact sur sa définition et donc sur la SCG. C'est pourquoi cet aspect a été pris en considération dans l'étude. Il inclut la classification des coûts dans plusieurs catégories (directs, indirects, variables, etc...), la définition de variantes du coût global (LCC, COT, COO, WLC) et leur utilisation.

Les résultats principaux de l'étude consistent en :

1. une structure générique de coût global (et les définitions associées) commune à tous les pays et pouvant être utilisée par n'importe quel programme militaire pour construire sa propre SCG,
2. une analyse des différents niveaux de coût global et leur utilisation dans le processus décisionnel.

La définition du coût global et son utilisations dans le processus décisionnel ne sont pas les seuls aspects à considérer. D'autres aspects concernent par exemple les méthodes et es outils de calcul et d'analyse, les données et les bases de données. Bien qu'importantes, ces considérations n'ont pas été incluses dans le périmètre de l'étude[1]. Ces questions pourraient faire l'objet d'une deuxième étude sur le coût global.

La structure générique de coût global élaborée par le GT devrait être expérimentée dans des programmes nationaux ou multinationaux. Cet exercice concerne non seulement la SGCG mais également les considérations traitant de son utilisation (LCC, COT, COO et WLC). Les conclusions de ces expérimentations devraient permettre de valider, de compléter et d'améliorer les résultats présentés dans ce rapport.

[1] L'estimation des coûts du cycle de vie est réalisée grâce à un ensemble de techniques de modélisation, de prévision et d'analyse du coût global de possession d'un système, à tout moment dans sa vie.

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Glossary of Terms and Acronyms

CBS	Cost Breakdown Structure
COO	Cost of Ownership
EBS	Equipment Breakdown Structure
GCBS	Generic Cost Breakdown Structure
GFF	Government Furnished Facilities
GFI	Government Furnished Information
LCC	Life Cycle Cost
LCCBS	Life Cycle Cost Breakdown Structure (equivalent to CBS)
LSAR	Logistic Support Analysis Record
NCO	NATO CALS Office
PHST	Packaging, Handing, Storage and Transportation
POL	Petroleum, Oil and Lubricant
POW	Programme of Work
SAS	Studies, Analysis and Simulation (RTO Panel)
SM	Specific Means
TOC	Total Ownership Cost
TOR	Terms of Reference
WBS	Working Breakdown Structure
WG	Working Group (SAS-028)
WLC	Whole Life Cost

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14. Abstract

In system analysis, a Cost Breakdown Structure may be considered as a tool that enables analysts to define and compute with Life Cycle Costs and decision makers to take decisions.

The way analysts and decision makers use Life Cycle Costs has necessarily an impact on its definition and thus on Cost Breakdown Structure. That is why this aspect has been taken into account in the study. This aspect includes the classification of costs into several categories (direct, indirect, variable, etc.), the definition of Life Cycle Costs variants and the use of each one.

The main results of the study consists of:

1. a Generic Cost Breakdown Structure and associated definitions that can be used by any military programme to construct its own Cost Breakdown Structure,
2. an analysis of the way to use Life Cycle Costs in the decision making process.

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Chapter 1 – INTRODUCTION

For many years cost has been a major factor when analysing military systems. This is not just the initial procurement costs but all resources consumed by utilisation and disposal of the war fighting equipment. Concepts such as Life Cycle Cost (LCC), Whole Life Cost (WLC), Cost of Ownership (COO) or Total Ownership Cost (TOC) are more and more frequently covered in any document dealing with system and cost analysis.

Most Nations have developed and use their own methods, tools and terminology. It is more challenging, however, for Nations to work together and use a common 'language' when addressing costing issues. This is why a study has been undertaken under the auspices of NATO to harmonise the most important aspects dealing with LCC.

1.1 COST BREAKDOWN STRUCTURE

Apart from general definitions such as "all costs from cradle to grave", LCC is more precisely defined in each project by the list of all the cost elements to be considered in its calculation. This list is usually described by a Cost Breakdown Structure (CBS) that may be different between Nations or even between programmes in one given Nation.

That is why the primary area of research has concentrated on developing a Generic life cycle Cost Breakdown Structure (GCBS) with associated definitions and an accompanying glossary of LCC terminology to support the GCBS.

1.2 AIMS AND USES OF LCC

In system analysis, a CBS may be considered as a tool that enables analysts to define and compute LCC and for decision makers to understand the costs considered and compared in option analysis. The way analysts and 'decision makers' use LCC has necessarily an impact on its definition and thus on CBS. That is why this aspect has been taken into account in the study. This aspect includes the classification of costs into several categories (direct, indirect, variable, etc.), the definition of LCC variants (LCC, TOC, COO, WLC) and the use of each one.

Definition of LCC and its uses in decision making process are not the sole aspects to be considered. Other issues concern, for example, methods and computational tools, data and databases. However important are these issues, they have not been included in the study that focused (simply) on life cycle cost rather than life cycle costing[1].

[1] Life cycle costing is a set of techniques for modeling, predicting and analyzing the Life Cycle Cost of a system, at any stage of its life.

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Chapter 2 – SCOPE OF THE STUDY

Annexes B and C present the Terms of Reference (TOR) and the Programme of Work (POW) worked out by the Exploratory Team SAS-E07. The work of the Group followed the anticipated programme but included additional considerations dealing with the aims and uses of LCC. Indeed, the Group considered that it was difficult to develop a tool such as a CBS without any consideration on how this tool would be used and for which purposes. The main steps of the study are listed below:

2.1 CONTRIBUTION OF OTHER NATO ENTITIES

Several NATO bodies, whose activities are connected to LCC, have been contacted for possible involvement in or contribution to SAS-028. One of them (NATO CALS Office – NCO) gave a positive answer and designated a representative in the working group.

2.2 REVIEW OF NATIONAL PRACTISES AND CBS

The two first meetings were devoted to the review of national practices in LCC area and the presentation of national Cost Breakdown Structures. Each representative provided other participants with national documentation.

These presentations demonstrated that LCC is taken into account by all Nations with similar objectives even if organisations and tools may be different. However, comparison of National CBSs lead the WG to recognise that they were based on very different approaches and that it would be difficult to aggregate those CBSs into a unique and common structure.

2.3 DEVELOPMENT OF A GCBS

As early as the second meeting, the WG started discussions to develop a new and common CBS. Development of this Generic CBS covered several meetings and the results are presented in Chapters 4 to 9.

2.4 DEFINITIONS AND USES OF LCC, TOC (OR COO) AND WLC

Life Cycle Cost (as a generic expression) covers in fact several concepts that may be used for different purposes. The differences between those concepts lay on the way categories of costs such as direct, indirect, fixed, variable, linked and non linked are to be included or not in the analysis. This aspect is developed in Chapters 10 and 11.

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Chapter 3 – NATIONAL CBS COMPARISON

Review and comparison of national CBS was the first tasks of the WG. National CBS are presented in Annex E. The examination of those CBS lead to the following remarks:

- Most high level cost elements are taken into account by all CBSs
- High level cost elements are more or less detailed by lower level elements and the same element may be at different indenture levels depending on the National preferences
- The number of cost elements differs very much between Nations
- Nations do not use the same terminology to designate equivalent cost elements

A comparison of national CBSs is presented in Annex F. Examination of this table confirms that the list and the breakdown structure of cost elements are very different between Nations. It also shows that it would be very difficult to derive a common CBS from all the various National CBSs.

Another point is to be considered. The list of cost elements presented in the left side of the Annex F table is derived from 7 national CBSs. It does not take into account other NATO Nations CBS that where not involved in the study. It follows that this list may not be representative for all Nations.

As a matter of fact, a national CBS is, implicitly or explicitly, the result of an analysis in which all possible cost elements are identified and put together into a breakdown structure. The seven CBSs are the results of seven different analysis based on different approaches. That is why the WG considered that it was easier to start a new analysis and develop a new CBS rather than trying to harmonise the specific results obtained by each nation.

The Group adopted this approach which satisfied all members. The main advantage is that it assists in the development of a generic CBS applicable to any kind of system and projects and by any Nation involved in a collaborative programme.

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Chapter 4 – DEVELOPMENT OF A GENERIC COST BREAKDOWN STRUCTURE (GCBS)

This chapter presents the methodology used by the Working Group (WG) to develop a Generic Cost Breakdown Structure (GCBS[1]).

First of all the working group has identified the requirements a Cost Breakdown Structure (CBS) has to fulfil and the steps a project team has to make in building a CBS (§ 4.1). Then the principle is explained how the cost elements on the lowest level of a CBS are established (§ 4.2). The next step is to actually build the GCBS (§ 4.3) and last, but not least, some attention is paid to the use of a CBS (§ 4.4).

4.1 REQUIREMENTS

A Cost Breakdown Structure must have the following characteristics:

Easy to develop	The CBS must be easy to develop, to use and to update
Comprehensive	All relevant cost items are to be identified
Comparable	At a certain level, all CBS could be compared, combined, etc.
Unambiguous	Definitions must be clear and cover all possible cost
Flexible	Each CBS must be able to be 'tailored' to the system or project and may evolve as the programme progresses through its life cycle.

The Generic Cost Breakdown Structure (GCBS) developed by the WG should allow any project team to build a CBS having the above-mentioned characteristics. The development of this GCBS has followed two steps:

1. Identify all relevant cost items associated to the project or the system.
2. Put together all those cost items into a Cost Breakdown Structure (CBS).

The main difficulty in step 1 is to be comprehensive; all relevant costs are to be identified. For this, one may use a checklist to ascertain that no cost item will be overlooked. However, it is not sure that it is possible to create such a comprehensive checklist to cover all possible systems. Assuming such a checklist could exist, it would include several hundreds of items and would therefore be very difficult to use.

The main difficulty in step 2 is to organise all cost items into a structure (a CBS) that makes it comparable, up to a certain level, with all other CBSs (whatever the nation, the project or the system) that are based on the same unambiguous definitions.

4.2 IDENTIFICATION OF COST ELEMENTS

In the analysis done by the WG it shows that, at the lowest level of a CBS, a cost element is usually associated with the following three basic elements: a resource, an activity and a product.

Examples

- Cost of consumables (resource) for the maintenance (activity) of an aircraft (product)
- Cost of personnel (resource) for the development (activity) of a computer programme (product)

[1] When applying the GCBS to a Programme, the result is a CBS tailored to the Programme.

Remark

At this point, the term "activity" is defined with a generic or ordinary meaning that is "to manufacture something", this something being generic (not mentioned) or explicitly mentioned (an engine for example).

At a higher level, a cost item may only refer to an activity applied to a product. For example, "maintenance of an aircraft" does not mention but includes the costs of all the resources (personnel, consumables, services, etc.).

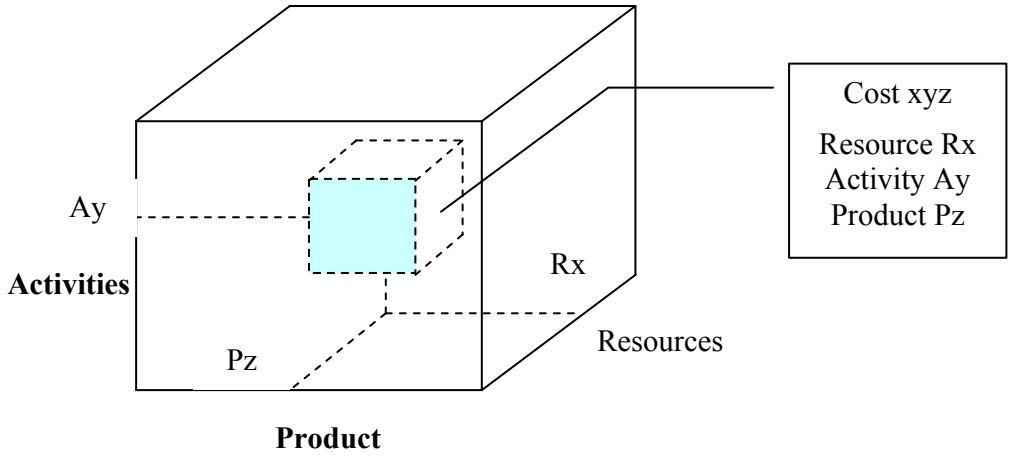
Its shows that, even if a cost element is implicitly associated to the three constituents (activity, product and resource), it may explicitly refer to only one or two of them. This combination may be represented by a code defined by several fields. The problem of cost elements classification using coding will be dealt with in Chapter 9. The first step of the analysis is to identify all possible cost elements in a way that meets the requirements defined in § 4.1.

Principle

As a cost element is always associated to a "resource" used by an "activity" applied to a "product", the first stage of the analysis is to define all possible resources, activities and products. This is the purpose of the three following primary structures or lists:

- The product tree defines all possible product elements that are of concern during the life of a system.
- The activity list defines all possible activities performed during the life of a system.
- The resource list defines all possible resources used by the activities.

The list of all cost elements is then obtained by combining the product tree, the activity list and the resource list. This is illustrated by the figure below.



The three primary structures are defined in Chapters 5, 6 and 7.

4.3 COMPILATION OF COST ELEMENTS INTO A CBS

The list of cost elements obtained in step one (identification) is usually very large and may prove difficult to use. That is why existing CBSs put together several cost elements into one cost item. That is the purpose of this step 2.

The list obtained in step 1 is already arranged in a logical way as defined by the crossing of the three primary structures. However, this breakdown structure is neutral in the sense that it puts at the same level all activities and all products. However, the primary purpose of the project is to deliver a required military capability (usually that is to operate the main system) that meets the operational requirements of the end user.

When dealing with a military system, all products and activities involved during the life of the system are not of the same level of importance. The main system (aircraft, tank, missile) is considered more important than the spares, support equipment and special tooling. Likewise, activities concerning the main system are more important than the same activities applied to support elements. For example, the two following activities are usually not placed at the same level:

A1 : operating the main system (in peacetime or in a crisis)

A2 : operating or using special tooling

A1 occurs in the in-service phase and represents the final goal of the military system. A2 may occur in the production phase and concerns tooling that contributes to the product but is itself not a contributor directly to military capability.

The phasing of the projects is also associated with the main system that will be designed, developed, manufactured and delivered to the buyer. That is why activities are usually classified into two categories concerning respectively the procurement and the use of the main system. Therefore it is possible that some costs associated with the use of some products may be considered as production costs of the main system. For example, the maintenance of a special tooling used in production is considered to be a production cost and not an in-service cost. The ‘in-service’ phase refers to the main system.

The phasing of the projects and the importance of the main system are usually the criteria considered when constructing a CBS. Not all of the activities and products are placed at the same level of importance or detailed assessment. The concept of materiality applies.

Like the cost elements obtained in step one, a CBS is defined by activities, products and resources. However, some CBS activities may have a different definition than the one mentioned in step one (identification) for they may cover several activities or concern a specific product. That is why there is a difference between a generic activity (with a common, generic, general meaning) and a CBS activity for which the definition may be more specific.

4.4 USE OF GCBS

The Generic Cost Breakdown Structure (GCBS) defines and arranges all relevant cost elements suitable for any project and any system.

This GCBS is a general and basic framework that is to be used in each Programme to build a CBS taking into account the specifics of the project (develop a new system, purchase a system off the self, etc.) and the kind of system (naval, armoured vehicle, aircraft, etc).

As it is shown in the next chapters, the CBS is based on the description of the product of the programme and its life cycle. It means that establishing a CBS is a very essential activity and is really providing crucial information for Project and Programme management.

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Chapter 5 – GENERIC ACTIVITY LIST

DEFINITIONS

Task: The most elementary process or piece of work to be done, especially one done regularly to obtain an expected result and specified in terms of performance, cost and time. The performance of a task is entrusted to an identified actor and usually requires human, material and financial resources allocation.

Activity: A consistent set of tasks (for example; to manufacture an engine, to test a sub-system, to maintain software, etc.).

The term activity may or not refer explicitly to a product. For example "to manufacture" and "to manufacture an engine" are both activities.

In this paragraph, the term "activity" is equivalent to "generic activity" for it corresponds to the usual meaning of an activity. The list of all possible activities that could be applied to a product during its life cycle is given below.

Management: The control and organisation of private or public undertakings.

Studies: Focused investigations to acquire information.

Analyses: Detailed examination of something, in order to discover more about it.

Simulation: Imitating real world events with a model for convenience or training.

Engineering: Application of science for the control and use of machines.

Purchase: An act of buying.

Manufacturing: Producing (goods) often in large numbers, especially in a factory using machines.

Integration: Combination of diverse elements into a whole product or assembly.

Test: Act of using something to find out whether it is working correctly or how effective it is.

Evaluation: Judging or calculating the quality, importance, amount or value of something.

Trials: Tests, usually over a limited period of time, to discover how effective or suitable something or someone is.

Demonstration: Providing logical proof that something is working correctly in the operational environment.

Packaging: Making/providing wrapping or containers for goods to protect them from damage.

Handling: Picking (something) up , hold or move it (by hand or machine).

Storage: Putting or keeping (things) in a defined area and often under specific environmental conditions for use in the future.

Transport: Take persons, goods, materiel from one place to another.

Training: To bring person(s) to desired state or standard of efficiency.

Installation: Establish in place ready for use.

Operation: Activity that is intended to achieve a particular purpose.

Maintenance: All actions taken to retain equipment in (or to restore it to) a specified condition, including inspection, testing, servicing, repair, rebuilding and reclamation.

Replenishment: Refilling or replacing items to maintain required levels of supply.

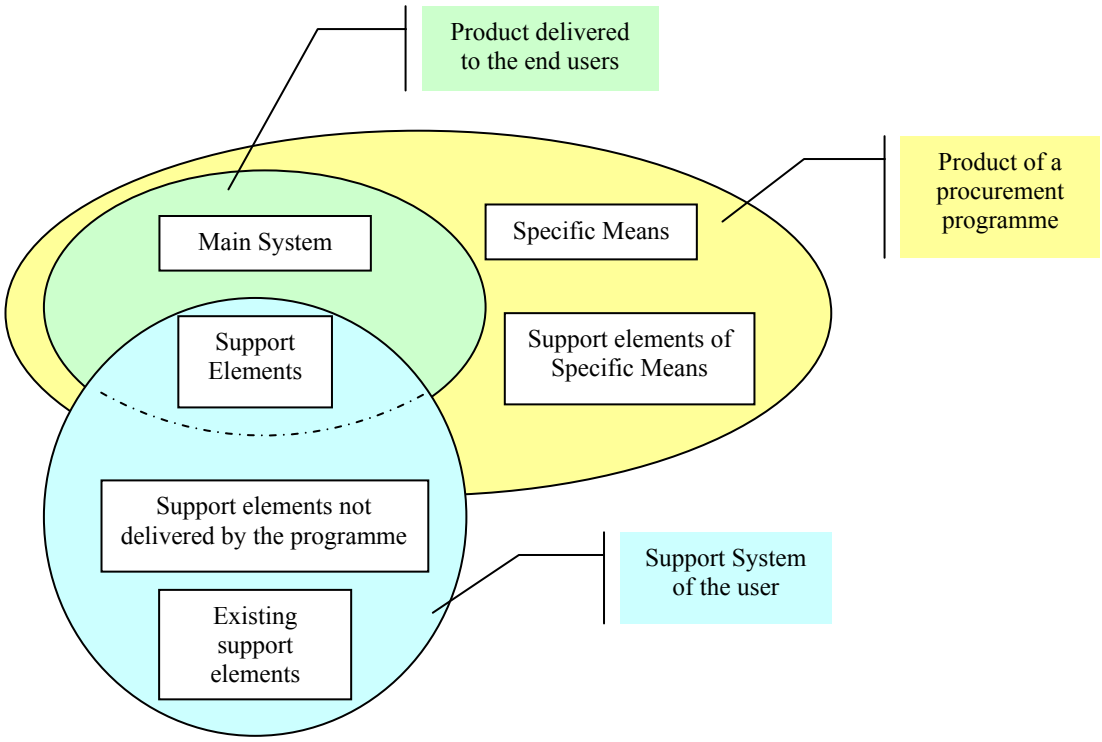
Most activities apply to a product (hardware or software) with the exception of management that applies to all activities and training that applies to people.

Chapter 6 – PRODUCT TREE

The product tree defines and describes the products of the programme. These include the products delivered to the user and the specific means required for developing and manufacturing these products.

The products delivered to the user encompass the main system (aircraft, tank, etc.) and its support elements (spares, support equipment, facilities, documentation, etc.).

The various elements are displayed in the following figure.



6.1 THE MAIN SYSTEM

The main system, both hardware and software, identified as deliverable end item(s), usually represented by standard equipment breakdown structures (EBS), is very different for air, land and sea equipment. It therefore cannot be described in a generic document.

6.2 THE SUPPORT ELEMENTS

Whatever the main system, the different categories of support elements are broadly common for all kinds of system. They include:

Data: all deliverable data and publications, e.g., manuals, engineering data, management data°, logistic data (LSAR) and maintenance plan.

Spare parts: components, assemblies, and subassemblies used for replacement purposes during maintenance.

Support equipment: Equipment and computer software required to maintaining, testing or operating a product or facility in its intended environment (Built-in equipment is not included, this is generally considered part of the main system).

Training equipment and material: all training equipment (simulators, etc.) and devices (course materials, …), accessories and aides used to facilitate instruction for the operation and the maintenance of the system. This does not include training activities.

PHST means: all means needed for packaging (for example containers), handling, storage and transportation of the main system and other support systems.

Facilities and infrastructure: industrial or government furnished facilities necessary for the operation and maintenance of the main system and its support systems.

6.3 THE SPECIFIC MEANS

Specific means (SM) cover all elements designed and developed, manufactured, if necessary modified and used within the programme, which are indispensable for the system procurement process, but which are not delivered to the end user. These may encompass tools of simulation, assembly facilities, test and trial facilities, etc. It also includes their support elements.

Specific means may be provided by Government or Contractor. In the first case, they are usually referred to as GFF (Government Furnished Facilities).

Chapter 7 – RESOURCES

The achievement of a task or an activity requires resources that may be provided by the contractor(s) (industry) or by Government. Most of the resources needed are similar for all kinds of systems.

Resources do not necessarily mean just financial resources but more directly the means to perform an activity. An important aspect is the difference between a resource and a product. This is explained in detail in Annex H.

The list of resources includes:

- Personnel
- Equipment
- Consumables
- Infrastructure/Facilities
- Services
- Information

7.1 PERSONNEL

Most activities, either on Government side or contractor side involve personnel.

On the Government side (internal staff), military and civilian personnel required to operate, maintain, and support a discrete operational system are to be considered. This includes the personnel necessary to meet combat readiness, unit training, and administrative requirements.

Personnel costs may be direct or indirect (see Annex G).

- Direct costs are usually associated to operators and maintainers of the system. For personnel that operate or maintain more than one type of system, costs are allocated on a relative (pro rata) workload basis.
- Indirect costs are usually associated with personnel required for unit command, administration, supervision, operation control, planning, scheduling, safety, fuel and munitions handling, etc. and are not so easily allocated to a specific system.

Personnel cost may include basic pay, social security contributions, retired pay accrual, all allowances (housing, clothing, overseas station, etc.) and bonuses.

7.2 EQUIPMENT

This resource includes all means (usually support equipment) that are used to operate or maintain the system but are not considered as a product of the programme because they are shared between several systems (see Annex H, Products and Resources).

For example, a piece of test equipment developed in the framework of a programme and used only for the acquired system is considered as a product of this programme. But a piece of test equipment already in use for other existing systems and used by the new one is considered as a resource for the new system.

Of course in both cases, the test equipment will be considered as a resource by the maintainer.

7.3 CONSUMABLES

Consumables are all resources, that are not considered as a product of the programme and that are consumed in order to operate or to support the main system. They include:

- Petroleum, oil and lubricants (POL) / Energy
- Ammunitions
- Non repairable parts (non repairable parts that are not included in initial spare parts are usually included in replenishment, that is why this entry is usually empty)
- Raw materials
- Water, food and clothing

7.4 INFRASTRUCTURE/FACILITIES

This resource refers to installations and facilities, that are not considered as a product of the programme, and that are used to support military forces. They include permanent, quasi-permanent, temporary, or mobile assets (such as buildings, roads, naval bases) required to support the system throughout its life cycle.

7.5 SERVICES

Services consist of assistance by contractors or sub-contractors. Services may also include transportation, if it is not included in PHST.

7.6 INFORMATION

Can include copyright information for which a fee is required or GFI.

7.7 THE PUBLIC AND THE PRIVATE SECTORS

There may be a difference in the representation of resources between activities performed by the public and private sectors. If the resources involved need to be detailed in public sector activities (personnel in various categories, consumables, services, etc.) it may be different for activities performed by the private sector for which the financial aspect is the more important (in this case, the resource is usually and implicitly “services”).

That is why resources are usually more detailed in activities dealing with the in-service phase than activities in development and production phases.

Chapter 8 – CBS ACTIVITIES

8.1 IDENTIFICATION OF COST ELEMENTS

Consider the list of generic activities defined in Chapter 5 and apply them to the 3 branches of the product tree: the main system (which is split up into hardware (HW) and software (SW)), the support elements and the specific means. The result is displayed in the following table.

Table 1

ACTIVITIES	PRODUCT TREE			
	Main System		Support System	Specific Means
	HW	SW		
Management	Project			
Studies, A&S				
Engineering				
Purchase				
Manufacturing				
Integration				NA
Test				
Packaging		NA		
Handling		NA		
Storage				
Transport		NA		
Training	Personnel			
Installation				
Operation				
Maintenance				
Replenishment		NA		NA
Disposal		NA		

If the list of generic activities is correct and comprehensive, the list of all possible activities can be derived by applying each generic activity to each product element. This development follows three steps:

Step 1: Two activities do not apply to products. Management applies to the project and training to personnel.

Step 2: Some activities are “not applicable” and must be removed from the list. For example, Packaging and Handling do not apply to Software.

Step 3: Each remaining cell in table 1 represents an activity applied to a product, that is to say a cost element.

An abstract of the list of all possible costs is presented in Annex I. Codes are numbered 01 to 17 for activities. Further indenture levels are developed to include the product tree and the list of resources. For example, 14-01-01 represents the personnel for operating the main system, 14-02-01 the personnel for operating the support system and 14-03-01 the personnel for operating the specific means.

As mentioned in § 4.3, this list of activities (or cost elements) puts all products at the same level and does not take into account the phasing of the project.

To solve those two points, a new list of activities (named CBS-activities) has to be defined.

8.2 FROM GENERIC TO CBS ACTIVITIES

The phases of a programme will be dealt with in paragraph 9 under 'coding'. Only the two main phases (or stages) "procurement" and "in-service" are considered here.

As most generic activities occur in the procurement phase and the in-service phase, CBS activities are defined from generic activities and product elements. A CBS activity may be:

a) Identical to a generic activity (same definition) but sometimes limited to a sub-set of products (for example "operation" becomes "operation of the main system").

b) A generic activity with a different meaning defined as a combination of generic activities, sometimes limited to a sub-set of product (for example "maintenance" becomes "maintenance of the main system and operation and maintenance of the support system").

c) A new activity defining a combination of generic activities, sometimes limited to a sub-set of the products (for example "delivery" includes packaging, handling, storage and transportation of the products delivered to the user).

The list of activities that will be used to develop the GCBS is presented in the next two paragraphs.

As mentioned in Chapter 9 (§9.3), the first field of the CBS sequences the phases of a programme by time. The phases defined by NATO nomenclature can be grouped into two categories. The first one put together all activities associated with the procurement of the system and second all activities associated with its utilisation.

8.3 ACTIVITIES IN THE PROCUREMENT PHASE

Nine activities are identified plus the activity "other".

8.3.1 Management

This element includes business management of the system/programme. It encompasses the overall planning, direction, and control of all phases of the programme. It includes the management of the project including cost, schedule and performance measurements, risk management, configuration control, contract management, Reliability Availability Maintainability (RAM), Integrated Logistic Support (ILS), Quality Assurance (QA) including reviews and quality audits and documentation tasks.

This element includes Government and contractor activities. As an IPT (integrated project team) follows the programme throughout the life of the system, this element may encompass the whole life cycle but certainly the procurement and the in-service phases.

It excludes those management activities covered by system engineering.

8.3.2 Studies, Analyses and Simulation

- **Studies and Analysis**

  All efforts culminating in paper products that establish potential solutions to outstanding areas of risk or problem definition.

This can include technology review, R&M, ILS and LSA studies, trade-off/risk reduction, basic researches, preparatory studies, the analysis of the initial need, the external functional analysis and a market survey and may also include user and system requirements.

- **Simulation**

  Non deliverable representations to prove concepts and allow testing. This can include digital and physical models aiming to demonstrate the feasibility of all or any part of a system.

8.3.3 Engineering

The effort required to develop a new capability to the point where it can be introduced into the operational inventory or to sustain the capability once fielded. It also includes efforts associated with pre-planned product improvements.

This includes:

- **System Engineering**

  This consists of the technical and management efforts of directing and controlling the totally integrated engineering effort of the architecture, system or programme.

- **Design and Development Engineering**

  It includes all of the activities to design and develop: technical, test and quality assurance specifications, engineering drawings, parts lists and wiring diagrams.

  It also includes the costs of raw and semi-fabricated material plus purchased parts consumed in the performance of component engineering efforts.

- **Design Changes**

  It concerns the possible evolutions of the system design appearing both before and after the initial deployment.

8.3.4 Purchase off the Shelf (Government or Commercial)

This may include the purchase or provisioning of the main system but also the purchase of major subsystems to be integrated by the manufacturer. This element captures systems not requiring significant additional development to meet the specified requirements.

This element excludes subcontractor's efforts and purchased parts/equipment for systems that have significant additional development efforts, which should be captured in the manufacturing activity.

8.3.5 Investment

This concerns all costs associated to develop, produce, modify, operate and maintain specifics means for both manufacturer and Government.

- **Tooling**

  This includes planning, designing, fabricating, purchasing, assembling, installing, modifying, inspecting, testing, maintaining and reworking all tools (including dies, jigs, and fixtures), inspection equipment, and test equipment supporting the development and production of a specified system component.

This includes the initial hard tooling and production line set up to support low-rate and full-scale production of the system.

- **Facilities**

  This includes any infrastructure such as new building, conversion or expansion of facilities or sites, and the procurement of real estate for developing, producing and testing (-operating and supporting-) the system. This includes facilities to handle or store hazardous materials or waste including underground storage tanks.

- **Reference Sets**

  This includes developing, manufacturing and purchasing interface equipment that allows compatibility checks and to try out modifications.

8.3.6 Manufacturing

This element includes the fabrication, test and checkout, processing, subassembly, final assembly, reworking modification, and installation of parts and equipment, power plants, boosters, electronic equipment, explosives, and the proving of such equipment and instruments for the specified system.

This element also includes subcontractor's efforts and direct material used in making the product. This includes raw materials and purchased parts/equipment. This does not include the purchase of major subsystems to be integrated by the manufacturer (purchase off the shelf).

The element further includes the efforts to integrate and assemble the various subassemblies into a working system, efforts to install special and general equipment, to paint and package the system for shipment to its acceptance destination, and efforts associated with pre-planned product improvements. It also includes moves in order to assemble into a final system. This element includes official alterations made to the system while it is still in the manufacturing process (before acceptance into service)

This element includes implementing quality control processes necessary to ensure that a manufacturing process produces a system that meets the prescribed standards. It includes such tasks as reliability testing, establishment of acceptable quality levels, statistical methods for determining performance of manufacturing processes, preparation and review of reports relating to these tasks and the performance of production acceptance tests.

The above definition applies for both prototype equipment and delivered equipment (user end items), but recognises that the manufacturing methods may differ.

8.3.7 Systems Integration

This includes the final integration of systems into a capability and ensures interoperability. Ensuring that all equipment, whether purchased off the shelf or bespoke manufactured, operates satisfactory to meet the mission objectives.

8.3.8 System Level Test, Evaluation, Trials and Demonstration

This element includes detailed planning, conduct, support, data reduction and reporting from system-level test activities, to include both supplier and user testing. It also includes efforts associated with pre-planned product improvements. This element also includes test items that are used or consumed in the conduct of such tests and specially fabricated hardware to obtain or validate engineering data on the performance of the system. Also included are all efforts associated with the design, production, and disposal of models, specimens, fixtures, instrumentation and hazardous materials in support of the test programme.

8.3.9 Deployment

This includes delivery and installation of main and support systems to operational sites, and includes initial training to operate and support the system.

- **Delivery (PHST)**

  This element includes moving materiel from the manufacturer to the first point of acceptance, receipt or storage point by the Contractor or Government. It includes conditioning, packaging, handling, storage and transportation activities to government operational sites.

- **Training**

  This includes training the trainers and other initial training courses through which personnel will learn to operate and maintain the system.

- **Installation**

  This includes installing all equipment at a location or at contractors' premises.

- **Acceptance Testing**

  This includes demonstrating that the system configuration works in an operational environment.

8.3.10 Other

This includes any activities not otherwise accounted for.

8.4 ACTIVITIES IN THE IN-SERVICE PHASE

Eight activities are identified plus the activity "other" and plus disposal that could be considered as the last phase of the programme following in-service phase.

8.4.1 Operation

This includes the operation of the system in peacetime circumstances, including deployment and exercises, to sustain operational proficiency and skill levels.

8.4.2 Mission Support

This includes commanding, administrating, supervision, operations control, planning, scheduling, safety, quality control, security, logistics, ground safety, fuel and ammunition handling, and simulator operations as well as for special mission support functions, such as intelligence, photo interpretation, etc.

This may also include functions such as communications, personnel services, base transportation, property maintenance etc.

These activities exist only to support the system whose costs are being estimated.

8.4.3 Maintenance

This includes maintaining a primary system, associated support equipment, and unit-level training devices.

This includes maintenance at all lines/levels such as on the equipment by crew, on the equipment by specialist repair personnel, by a depot or agency and industry (interim or continuous; this might be part of a logistic

support package). This includes detection, inspection, trouble shooting, prevention, testing and calibration, overhaul, and replacement of parts, components or assemblies. A distinction is made between planned and unplanned maintenance.

Planned: This covers all activities carried out at regular time and performance intervals. Therefore, the terms "scheduled" or "preventive maintenance" are also used.

Unplanned: This covers all work that is not categorised as planned maintenance, such as the repair of defective equipment/subsystems/replacement parts. Therefore, the terms "unscheduled" or "corrective maintenance" are also used.

8.4.4 Replenishment

This includes re-provisioning for the routine replenishment of stocks as well as the enhancement of existing stock levels to support the introduction of new equipment after the agreed initial provisioning support period.

8.4.5 Continuation Training

This includes system-specific training (non-procurement funded) and speciality training for military personnel who are replacing individuals lost through attrition or rotation. It also includes noncombat operations (such as firepower demonstrations) and training exercises.

8.4.6 PHST

This includes packaging, handling, storing, and transporting (PHST) of primary mission and support equipment, repair parts, secondary items, POL, and ammunition to and from operations and training areas. It may also include transportation of items procured or shipped by the unit. Excluded are PHST costs for repairables acquired through stock fund reimbursements.

8.4.7 Sustaining Support

- **Modification Kit Procurement/Installation**

  This includes procuring and installing modification kits and modification kit initial spares (after production and deployment) required for a defence system and related support and training equipment. This includes only those modification kits needed to achieve acceptable safety levels, overcome mission capability deficiencies, improve reliability, or reduce maintenance costs. It excludes modifications undertaken to provide additional operational capability not called for in the original design or performance specifications.

- **Sustaining Engineering Support**

  This includes providing continued systems engineering and programme management oversight to determine the integrity of a system, to maintain operational reliability, to approve design changes, and to ensure conformance with established specifications and standards. This may include (but are not limited to) government and/or contract engineering services, technical advice, and training for component or system installation, operation, maintenance, and support.

- **Software Maintenance Support**

  This includes the update, maintenance and modification, integration, and configuration management of software. It includes operational, maintenance, and diagnostic software programmes for the primary

system, support equipment, and training equipment. Excluded are major redesigns, new development of large interfacing software, or modifications that change functionality.

8.4.8 Restoration

This includes all activities associated to restoration (or renovation) of a system carried out for example at mid-life. As this activity may include modifications undertaken to provide additional operational capability not called for in the original design or performance specifications, it could be considered as a new procurement occurring during the in-service phase of the system.

8.4.9 Other

This includes any significant sustaining support not otherwise accounted for. Examples might include follow-on operational tests and evaluation, such as test range use, test support, data reduction, and test reporting.

8.4.10 Disposal

This includes demilitarisation, detoxification, or long-term waste storage when disposing of operational or associated support equipment.

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Chapter 9 – CODING A CBS

9.1 BASIC CONSIDERATIONS

The Cost Breakdown Structure (CBS) establishes a standard vocabulary for identifying and classifying the costs of a system. The CBS is designed to capture all relevant costs across the life-cycle of a programme. This section will describe the approach to developing a coded CBS and is generic in its treatment of the CBS. Individual applications of this document should tailor the CBS coding to accommodate the unique characteristics of the system(s) being investigated, and this section will also mention ways in which the CBS coding might be tailored. The resulting CBS should be checked to ensure that all relevant costs are represented.

When constructing the CBS of estimating system costs, one should consider not only the system being assessed but also the maturity of the system definition and the accuracy expected from the estimate. For example, a cost estimate, and its associated CBS, developed in the Feasibility Phase will often not be as detailed as an estimate developed in the Production Phase.

As a programme matures, the cost model, the CBS, and the estimating methodology should be adapted to accommodate more precise information. The basic CBS should not change as a system matures. Rather, the basic elements and sub-elements should be expanded to capture greater levels of detail.

For this reason, the coded CBS discussed in this section is hierarchical in the sense that the sum of each set of lower indented elements equals the next higher indented element. This approach allows flexibility in selecting the level and method by which the various cost elements will be estimated.

9.2 THE IDEALISED CBS ELEMENT

Each element in the coded CBS comprises five fundamental fields that capture the logic of the CBS discussed in the preceding sections of this report. The five fields are listed in the table below:

1st field	Phase of the Programme
2nd field	Resources Applied
3rd field	Activity Done
4th field	Resulting Product
5th field	Product Detail (WBS)

Thus, each element captures, within a particular phase of a programme, the costs of applying a set of resources in a well-defined activity to produce a given amount of product output.

The output is defined generically by the 4th field as Main System, Support System, or Special Means, and with greater specificity by the 5th field through the introduction of a standard Work Breakdown Structure (WBS), as captured, for example, in the U.S. MIL-HDBK-881 or the German PROSIS (Projekt- Steuerungs- und Informations- Standardverfahren).

The coding process begins by constructing code substructures for each field. Each field is divided first into mutually exclusive (from a cost perspective) elements, which are called level-one elements. Should any of these elements be further divided, decimal points are used to delineate lower levels of division and the number of non-zero numerals separated by decimal points indicates the element's level. Thus, a code of 6

indicates a level-one element; a code of 1.1 indicates a level-two element; a code of 1.1.1.0 indicates a level-three element; etc.

When this process is complete, a coded element within the CBS is simply a concatenation of the coded substructures developed for each field. For example, suppose the following substructure codes for the items in each of the five fields had been developed for an aircraft programme:

1st field	Production Phase	6
2nd field	Contractor Labour	1.1
3rd field	Manufacturing Rework Modification	5.2
4th field	Air Vehicle (Main System)	1
5th field	Air/Speed Brakes	1.1.1.8

Then, the contractor's labour costs associated with rework on the air/speed brakes in the production phase would be captured in the coded cost element 6.1.1.5.2.1.1.1.1.8.

When constructing a structure with one or more indented levels below the first level, the following rules will apply:

1. A zero appearing at the end of the code indicates that the element has at least two sub-elements below. That is, a code of 1.0 indicates the element can be further broken into at least two sub-elements, which would be labelled 1.1, 1.2, …, 1.n.
2. The sum of the level_(k+1) sub-elements of equal indentation (i.e., the first k numerals are identical for each sub-element) equals the higher level_k element ending in zero. That is, the sum of the level-2 sub-elements 1.1, 1.2, …, 1.n must equal 1.0.
3. An element ending in a numeral other than zero indicates that no further subdivision is defined.

9.3 CODING THE FIELDS

The coding process begins by constructing code substructures for each field. The first field sequences the phases of a programme by time. Using standard NATO nomenclature for these phases, the coded phase substructure would appear as follows:

1	Mission Need Evaluation Phase
2	Pre-feasibility Phase
3	Feasibility Phase
4	Project Definition Phase
5	Design and Development Phase
6	Production Phase
7	In-service Phase

Individual programmes might exclude certain phases and should tailor the above structure by deleting the excluded phases. For example, a programme to purchase an off-the-shelf system would likely exclude many of the phases prior to the production phase. Such a programme might, therefore, numerate only two to four phases for the first field.

More mature programmes should also tailor the phase code substructure to combine completed phases into a single entry labelled "sunk costs." For example, a programme that is on the verge of entering production might use the following code substructure for the first field:

1	Sunk Costs
2	Design and Development Phase
3	Production Phase
4	In-service Phase

The resource field code substructure has two major divisions: contractor (external) resources and government (internal) resources. The choices of sub-elements will always be tailored to the procurement and deployment strategies underlying the programme and will be driven by factors such as participating national budget structures, contractor support in the in-service phase, and fidelity of cost databases and estimating models.

Consider an example of an aircraft programme in which the contractor designs, develops, and manufactures the aircraft and in which government personnel at government-owned facilities operate and maintain the aircraft. Under this scenario, the **resource field coded substructure** might look as follows:

1.0	Contractor Resources
1.1	Labour
1.2	Material
1.3	Facilities
1.4	Services
2.0	Government Resources
2.1.0	Personnel
2.1.1	Military Personnel
2.1.2	Civilian Personnel
2.2.0	Equipment and Consumables
2.2.1	Equipment or Assets
2.2.2	POL/Energy
2.2.3	Munitions
2.2.4	Non-repairable Parts
2.3	Facilities
2.4	Services
2.5	Information

In this example, element 1.0 is the sum of 1.1 through 1.4, none of which are further broken down. Element 2.0 is the sum of the five level_2 elements 2.1.0, 2.2.0, 2.3, 2.4, and 2.5. Elements 2.1.0 and 2.2.0, ending in zero, indicate further subdivisions of each element, and each would equal the sum of the level-three sub-elements below it.

The **activity field** has two possible substructures, depending on the phase. For a procurement phase (mission-need evaluation through production), the substructure would be similar to the following:

1	Studies, Analyses, and Simulation
2.0 2.1 2.2 2.3	Engineering Systems Engineering Design and Development Engineering Design Changes
3.0 3.1 3.2 3.3	Investment Tooling Investment Facilities Investment Reference Sets Investment
4	System Test and Evaluation
5.0 5.1 5.2 5.3	Manufacturing Assembly, Test, and Checkout Rework Modification Installation
6	Purchase off the Shelf
7	Systems Integration
8.0 8.1 8.2 8.3 8.4	Deployment Delivery (PHST) Training Installation Acceptance Testing
9	Programme Management

For the in-service phase, the activity field substructure uses the operating and support activities definitions and would be similar to the following:

1	Operation
2	Mission Support
3.0 3.1 3.2 3.3	Maintenance Level 1 Maintenance Level 2 Maintenance Level 3 Maintenance
4	Replenishment
5	Continuation Training
6	PHST
7.0 7.1 7.2 7.3 7.4	Sustaining Support Modification Kit Procurement/Installation Sustaining Engineering Support Software Maintenance Support Other
8	Disposal

Tailoring of either of these activity field substructures would depend on the individual programme, although, in general, almost every programme would comprise each and every activity in both the procurement and in-service phases.

The fourth field provides a generic description of activity output (**product**) and would appear as follows:

1	Main System
2.0	Support System
2.1	Support Equipment
2.2	Operational Equipment
2.3	Training
2.4	Data
2.5	Spare Parts
2.6	Facilities and Infrastructure
3	Special Means

The product is further detailed in field five through use of standard WBSs, which are defined for various commodity classes. For example, an aircraft programme would use a WBS similar to the one below for detailing the main system. The WBS for an aircraft defines 15 level_one elements, from airframe through auxiliary equipment. Each of these elements is further divided, although the table shows only lower sub-elements for the airframe. The airframe element is divided into two level_two sub-elements: structure and equipment. Each of these level_two elements is further divided, and the table shows lower sub-elements only for the structure. The structure element is divided into seven level_three sub-elements. Note that not all of these sub-elements are further divided. Specifically, the nacelles/pylons and doors have no lower level of detail. The table does show that the fuselage element is divided into 13 level_four sub-elements.

1.0	Airframe
1.1.0	Structure
1.1.1.0	Fuselage
1.1.1.1	Forward Fuselage/Structure
1.1.1.2	Centre Fuselage/Structure
1.1.1.3	Aft Fuselage/Structure
1.1.1.4	Floor
1.1.1.5	Canopy
1.1.1.6	Radomes
1.1.1.7	Fins
1.1.1.8	Air/Speed Brakes
1.1.1.9	Air Inlets, Air Induction
1.1.1.10	Exhausts
1.1.1.11	Power Plant Mounts, Engine Mounts
1.1.1.12	Integrated Fire Walls
1.1.1.13	Other Mounts, Racks
1.1.2.0	Wings
1.1.3.0	Empennage
1.1.4.0	Landing Gear
1.1.5	Nacelles/Pylons
1.1.6	Doors
1.1.7.0	Dynamic Systems and Components
1.2.0	Equipment
2.0	Propulsion
3.0	Applications Software
4.0	System Software
5.0	Communications/Identification
6.0	Navigation/Guidance
7.0	Central Computer
8.0	Fire Control
9.0	Data Display and Controls
10.0	Survivability
11.0	Automatic Flight
12.0	Central Integrated Checkout
13.0	Armament
14.0	Weapons Delivery
15.0	Auxiliary Equipment

9.4 CODING THE CBS

Once the field coded substructures are defined, the process of building the coded CBS can be completed. The last step, in general, is to decide which resource-activity-product combinations appear in each programme phase and concatenate the corresponding codes. As above, the following coding rules apply to this final step:

1. A zero appearing at the end of the code indicates that the element has at least two sub-elements below. That is, a code of 1.0 indicates the element can be further broken into at least two sub-elements, which would be labelled 1.1, 1.2, …, 1.n.
2. The sum of the level_(k+1) sub-elements of equal indentation (i.e., the first k numerals are identical for each sub-element) equals the higher level-k element ending in zero. That is, the sum of the level_2 sub-elements 1.1, 1.2, …, 1.n must equal 1.0.
3. An element ending in a numeral other than zero indicates that no further subdivision is defined.

Some examples will illustrate the last step and refer to the coded substructures presented above.

- Total Production Phase costs are coded as 6.0. The ending zero indicates that further detail is defined.
- Total contractor labour costs (code 1.1) in the Production Phase are coded as 6.1.1.0.
- Total contractor labour costs for manufacturing rework (code 5.2) in the Production Phase are coded as 6.1.1.5.2.0.
- Total contractor labour costs for manufacturing rework on the air vehicle (code 1) in the Production Phase are coded as 6.1.1.5.2.1.0.
- Total contractor labour costs for manufacturing rework on the air vehicle's air/speed brakes (code 1.1.1.8) would be captured in the coded cost element 6.1.1.5.2.1.1.1.1.8. The lack of an ending zero indicates no further sub-elements are defined.

It is not necessary that all five fields be filled and the code end in a zero, as the first four examples illustrated. Field five is only applicable to the main system, so cost elements capturing costs associated with the support system or special means would not have a fifth field, unless defined for the individual programme. Both fields four and five could be excluded from the coding, with the implicit assumption that the resource-activity pair applies to the entire system. For example:

- In the Design and Development Phase (code 4), the costs of all contractor resources (code 1.0) for design and development engineering (code 2.2) of the peculiar support equipment (code 2.1.1) is coded as element 4.1.0.2.2.2.1.1. Here, the coded element used only the first four fields, since the fifth field (main system WBS) is not applicable.
- In the Project Definition Phase (code 3), the government's (code 2.0) system engineering efforts (code 2.1) are coded as 3.2.0.2.1. Notice here that both the fourth and fifth fields have been excluded. In this case, the coding implies that the system engineering activities apply to the entire system and will be costed as such. Thus, no further sub-elements are required.

Cost elements in the in-service phase (code 7) are coded in the same way as the examples above, using the operating and support activities substructure in field three rather than the procurement activities substructure. For example:

- The costs of military personnel (code 2.1.1) to perform level 1 maintenance (3.1) on the main system (code 1) are coded as 7.2.1.1.3.1.1.
- The costs of repairable parts (code 2.2.5) consumed in level 3 maintenance (3.3) on peculiar support equipment (code 2.1.1) are coded as 7.2.2.5.3.3.2.1.1.

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Chapter 10 – THE USE OF LIFE CYCLE COST

In this chapter, LCC is used as a general term and covers all concepts (LCC, TOC and WLC) that will be differentiated in Chapter 11.

The use of life cycle cost must, whatever the phase of a programme, inform the process by which managers can bid for future expenditure, manage existing budgets and make the best decisions on options presented to them.

- Economic Appraisals are generally undertaken by organisations and Government bodies with an eye to the 'well being' of that organisation or country as a whole. As such they address opportunity costs (alternative use of assets or resources) but usually not simple transfer payments such as national taxes that 'move around' the economy. Economic analysis may be simply summarised as addressing the costs and benefits of options to the national coffers and is not, necessarily, therefore concerned about precisely which part of the Department's budget is impacted. Any common costs not impacting the decision may be excluded to simplify, and hence reduce the costs of, the exercise.
- Financial Appraisals however include all cash flows and transfer payments and hence assess affordability. In financial appraisal, costs need to be split by budget holder, so they know their contribution, by phase to understand the significance over the life cycle and by major 'input' cost category (manpower, stocks purchased, in year expenses etc).

These two types of appraisal, although different, are not exclusive. They can make LCC a management and engineering tool with which to forecast and optimise the costs of a system. Whatever the type of use, the predictive use of LCC represents its principal interest.

LCC must be used as a benchmark against which options can be measured for 'value for money' during the procurement process, bearing in mind that the greatest opportunities to reduce LCC usually occur during the early phases of the programme. It follows LCC is used as a decision and optimisation criterion in the search of the best compromise between time, cost and performance.

10.1 PHASES IN THE USE OF LCC

Early in the project life cycle, studies need to address the capability gap, the numbers of equipment or platforms required and the technologies that can help to fill the gap at lowest cost. This requires a 'strategic' approach that can provide a capability to look at the 'big picture'. At this phase in the life cycle it is unlikely that the costs can be identified in a great deal of detail, rather an understanding of the 'big hand-falls' in terms of primary CBS elements and the uncertainty surrounding these figures is required.

Once a project team has been formed and given a user requirement, the focus turns to the performance, cost and time envelope of various options that will meet the requirement. Forecasts of costs for new equipment and platforms are needed. This requires an approach and tools/models that have a holistic view and can provide a 'what if' capability. The CBS can be developed and extended to reflect the acquired knowledge of the expected system characteristics.

When the preferred generic option (e.g. develop a new vehicle) is identified, industry is generally asked to compete for its supply. Assessments of these bids are based on life cycle cost analysis and need to address economic and financial treatments. Cost figures need to be compliant with rules set by Governments on investment appraisal set out by central Government (usually the country's Treasury department) and at the

same time provide the data by which budgets can be agreed for the long term operation and support of the assets. At this stage the CBS should be fully developed such that all cost elements are identified.

For in-service equipment a forecast of the costs for the remaining life are required. Whilst any in-service equipment, not nearing the end of its service life is generally considered to be in the middle of the 'bathtub' in respect of reliability, major cost drivers are driven by 'change milestones' caused by events such as overhaul, deployment, updates and safety reviews. Towards the end of equipment life, ageing effects may increase support costs or reduce availability. Not all equipment goes out of service on a particular date so phasing out expenditure depends on the introduction profile of new equipment or capability. Delays to new equipment can result in extra funds being required to continue support of legacy equipment. These costs need to be addressed and budget adjustments need to be calculated.

In summary, it is not possible or desirable to collect and analyse information at the same level of detail throughout the life cycle although there should be a common thread in terms of programme phases, main CBS groupings and resource consumption.

10.2 ECONOMIC APPRAISAL

These usually take the form of a cost benefit analysis or cost effectiveness analysis.

A cost benefit analysis is an exercise in which all of the costs and benefits of an activity are quantified and valued in monetary terms. It is therefore possible to evaluate and compare options and see if the benefits exceed the costs i.e. 'send to save'. Benefits, such as reduced loss of life, may be set against expenditure although there may be ethical objections to this approach.

A cost effectiveness analysis compares the costs to be expended (often discounted in later years to reflect the national time preference when spending money obtained through taxation) with the effectiveness of alternate ways of meeting an objective. By combining the analysis a measure of cost effectiveness can be obtained that can be used to decide between options.

In both cases it is possible to address just the marginal cost change from the 'status quo' if the other fixed costs apply equally to all options. It is important not to assume cost savings that can not be realistically achieved.

10.3 FINANCIAL APPRAISAL

The control of costs requires knowledge of current and, probable, future expenditure against assets and services. Because financial appraisal deals with budgets it is important that it is comprehensive in its coverage. Any cost breakdown structure must capture all costs.

Each nation will have their own financial control systems and these will demand different cost elements. Any CBS must therefore be as consistent as possible with each national system.

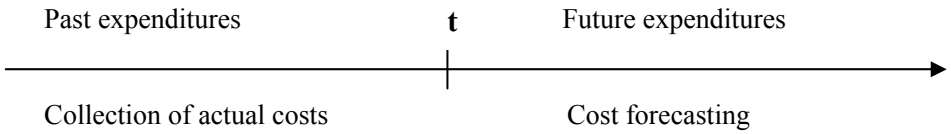
In financial appraisal it is not appropriate to employ discounting but it is important to consider all of the resources consumed in meeting an objective and any taxes that fall to a Department's budget. These will vary by country and need to be identified separately.

Two approaches are generally employed. Financial accounting deals with day to day budget control and is concerned with detailed costs. It may be less concerned with equipment costing and does not usually provide data that can be easily related to an equipment's CBS. Management accounting takes the same basic data but permits day to day project control and decision support. This is where an equipment CBS is most appropriate.

10.4 TIME RELATED EVALUATION FACTORS

At any time "t" in its life cycle, a system usually contains two categories of costs:

- Past expenditures usually referred to as "sunk costs" and firm undertakings that can not be undone without financial loss known as "committed costs".
- Future expenditures that can be amended even if there are political or severe structural implications.



To support forecasting of LCC it is essential to have a good knowledge of actual procurement and in-service costs. Collection of actual costs during the system life cycle helps:

- to analyse differences between forecasting and actual costs,
- to feed costs databases,
- to identify cost drivers,
- to implement management control.

Any CBS must be as consistent as possible with each national "costs collecting" system although it is recognised that this depends to a large extent on the structure, and thus commonality of systems, even within one country's financial or management systems. For the exchange of data or comparison of costs within NATO it will be necessary to understand the background to the purpose behind the use of LCC and if necessary 'translate' that information into a form that can be 'mapped' to a common CBS – as proposed in this document.

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Chapter 11 – LCC, TOC AND WLC

Life cycle costs of a system consist of all costs to be made by the owner of the system to acquire, to exploit against the required performance requirements and to dispose of the system.

This is a rather generic definition of Life Cycle Cost and does not give a decisive answer whether some cost elements or expenses can be attributed to a system.

Furthermore, throughout the world many different phrases are used to define Life Cycle Costs. Sometimes also different names are used to define the same thing. To find unity in definitions and terminology used in the area of Life Cycle Costing was one of the tasks of task group SAS-028.

In this chapter a distinction is made between Life Cycle Cost (LCC), Total Ownership Cost (TCO) and Whole Life cost (WLC) and these are described and clarified in more detail. Hereto the definitions for linked and non-linked, direct and indirect, variable and fixed costs as given in Annex G: Clarifications of Costs, are used.

If it is clear that direct costs are to be considered when dealing with Life Cycle Cost, several questions are raised when it comes to indirect costs. To help people give harmonised answers, several concepts have been defined that cover an increasing range of costs.

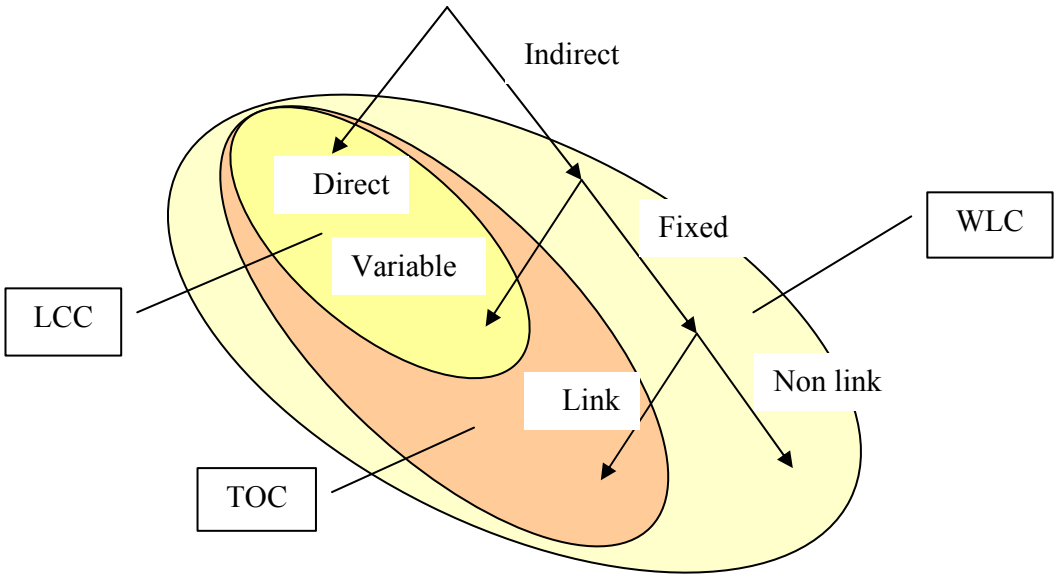
11.1 DEFINITIONS

LCC Life Cycle Cost = Direct costs + Indirect Variable costs

TOC Total Ownership Cost = LCC + Linked Indirect Fixed costs

WLC Whole Life Cost = TOC + Non linked Indirect Fixed costs

These definitions are graphically clarified in the figure below.



11.2 LCC

Life Cycle Cost (LCC) consists of all direct costs plus indirect-variable costs associated with the procurement, O&S and disposal of the system. Indirect costs may include linked costs such as additional common support equipment, additional administrative personnel and non-linked costs such as new recruiters to recruit additional personnel.

All indirect costs related to activities or resources that are not affected by the introduction of the system are not part of LCC.

Nature of Decision

LCC comprises the marginal costs (both direct and indirect) of introducing a new equipment or capability. LCC is used as a minimum for the analysis of alternatives, it does not include notional allocation of costs, whereas TOC and WLC might do so.

LCC is used to compare options of alternatives, and often for economic analyses.

11.3 TOC

Total Ownership Costs (TOC) consists of all elements that are part of LCC plus the indirect, fixed, linked costs.

These latter may include items such as common support equipment, common facilities, personnel required for unit command, administration, supervision, operations planning and control, fuel and munitions handling.

Nature of Decision

TOC represents all costs associated with the ownership of a system except non-linked fixed costs that are related to the running of the organisation.

TOC is used for budgeting purposes, determining the use of services between systems, for optimisation purposes and for financial analysis.

11.4 WLC

Whole Life Costing (WLC) consists of all elements that are part of TOC plus indirect, fixed, non-linked costs. These latter may include items such as family housing, medical services, ceremonial units, basic training, headquarters and staff, academies, recruiters.

In WLC all costs or expenses that are made by the organisation are attributed to the systems or products they produce.

Nature of Decision

As WLC represents the total budget provision including such element as headquarters costs, it allows the visibility of the complete allocation of funds.

WLC is used for a strategic view and high level studies.

11.5 EXAMPLES OF USING LCC, TOC AND WLC

To explain if a cost element should be included in LCC, TOC or WLC, some examples are given.

1. The product of a programme A includes the main system A and a training equipment TE to train the operating personnel of main system A. Training equipment TE is exclusively used to train operating personnel of main system A.

   Costs of training equipment TE are allocated to system A as direct costs and are part of LCC, TOC and WLC.

2. Later on, a new programme B is started that includes main system B. Main system B uses also training equipment TE already existing in the organisation and common with system A. The introduction of new main system B requires an additional piece of training equipment TE.

   The cost for the procurement of an additional extra piece of training equipment TE is allocated to system B and is considered as indirect-variable costs. This means that it is part of LCC, TOC and WLC.

3. The new main system B uses also training equipment TE already existing in the organisation an common with system A. No additional piece of training equipment TE is required due to the introduction of this new main system B.

   The cost for training equipment TE is allocated to main systems B as indirect fixed cost. This means that this cost will not be part of the LCC of system B. It will only be part of TOC and WLC.

4. Maintenance of system A is performed at intermediate level by maintainers who work exclusively for this system.

   Associated labour costs are direct costs. Those costs are assessed on the basis of the number of persons dedicated to the maintenance and not the workload. This means that these cost are part of LCC, TOC and WLC.

5. Those maintainers at intermediate level perform the maintenance for both systems A and B.

   Associated labour costs are direct costs for both systems A and B. This is based on the assumption that the time dedicated to the maintenance can be measured separately for each system. Those costs are assessed on the basis of the workload generated by each system. This means that these cost are also part of LCC, TOC and WLC.

6. In example 5, foremen are in charge of planning and inspecting the work performed by maintainers for several systems.

   Associated labour costs are indirect costs for systems B. They can be assessed on the basis of an equal share between systems or of the workload generated by each system. If the introduction of B has not increase the number of foremen, these indirect costs are fixed for B. This means that these cost are not part of LCC and are only considered as part of TOC and WLC.

7. Non-linked costs are always indirect. The non-linked (indirect) costs cannot be readily associated to the new system A. An example of non-linked fixed is the cost for the management or the headquarters.

   These costs are only taken into account in case of WLC, where a share is made for these cost between all systems. These costs are not part of LCC or TOC.

8. However, if as a result of the procurement of the new system A the headquarters has to be extended, e.g. with new recruiters that will recruit new personnel, these costs are related to the procurement of system A.

   The costs for the extension of the headquarters as a result of the procurement of the new system A, can be considered as a non-linked indirect variable cost. These costs are therefore part of LCC, TOC and WLC

If we would like to compare two systems the following applies:

Ship A versus Ship B: Use LCC if system A and B have the same indirect costs.

Ship A versus Submarine B: Use TOC if system A and B have different linked indirect costs.

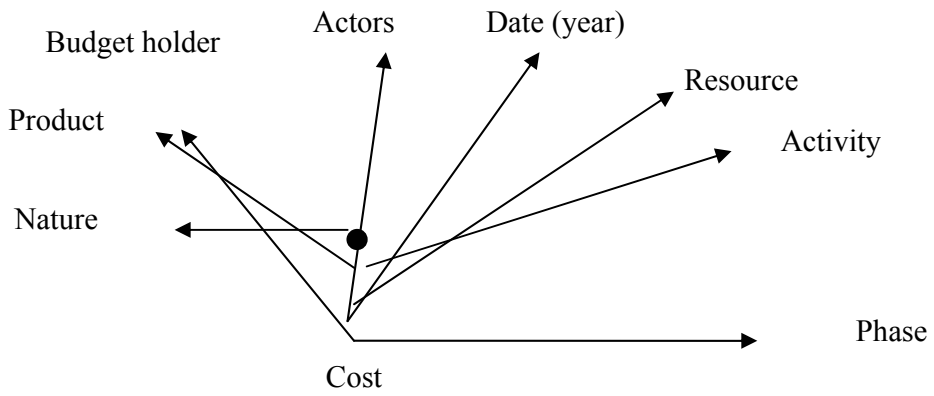
UAV A versus manned Aircraft B: Use WLC if system A and B have different non linked indirect costs.

If we use cost analysis for optimisation purposes, indirect costs may be included to highlight utilisation of e.g. infrastructure to see if a more optimal total utilisation exists.

Chapter 12 – CONSTRUCTION OF A CBS

12.1 THE COSTS DATABASE (CDB)

Each cost element of a CBS can be defined by a record containing the following information: phase of the Programme, activity, resources, date of the activity, actor in charge of the activity, budget holder concerned with the expenditure, product concerned by the activity, nature of the cost (direct, indirect, fixes, variable, etc.).



The set of these records amounts to a multidimensional cost database (CDB) that can be consulted with queries defined by keys.

Example of queries

1. All costs of the engine AE (of an aircraft A) sorted by phase (key 1), activity (key 2) and resource (key 3). The answer will be CBS of the engine in which 3 fields (phases, activities and resources) will define the codes.
2. All Government personnel costs sorted by phase, activity and product.

If one considers the axes mentioned previously, each cost element is characterised by 8 types of information.

The application of the 3 keys in example 1 makes it possible to give a linear representation (a list of costs) of the multidimensional database. This linear structure is then defined on 3 indenture levels (phase, activity and resource).

Any linear representation (in the way of a list) of the CBS results necessarily from an “a priori” choice of sorting keys associated to the axes of the multidimensional CDB.

The CBS can thus be considered according to two points of view: the multidimensional costs database (form-N) and the linear representation (form-1). The structure of a form-1 CBS is defined by the selection of successive axes. It is thus possible to associate several “form-1 CBS” to a given “form-N CDB”.

It is also possible to represent a CBS by a table (form-2). Compared with form-1, this representation has the advantage of reducing the choice of sorting keys, thus giving more flexibility in the use of the CBS.

Form-1 (a list) and form-2 (a table) are the only ways to represent a cost database (CDB) on a computer screen or a sheet of paper.

12.2 GCBS FORM-2 (TABLE)

The international and usual practices impose the choice of the first axis (sorting key), that is the phases of a programme, as defined by standard NATO nomenclature presented in § 9.3. However, this nomenclature could be adapted if one considers that it is out of date.

The following axis usually include “activities”, “product” and resources. In the GCBS form-2 (table), the product is usually described by columns.

An example of such GCBS is presented in Annex K.

12.3 GCBS FORM-1 (LIST)

To pass from a table to a list, the product elements defined in the columns must be transferred to lines created in the most appropriate manner for the project.

An example of such a CBS is given in Annex L.

Chapter 13 – CONCLUSION

All national CBSs presented in Annex E are made of the same kinds of items. They all refer to phases, product (main system or support element), activities or resources. But the differences between these CBSs are such that it proved impossible to put them together into one unique CBS. To elaborate a generic CBS complying with the requirement mentioned in § 4.1, the WG has analysed the three components (activities, product and resources) that, along with others such as actors (contractor, users, etc.) and time, identify the life cycle of a system.

One result is a generic CBS that can be used by any Nation, project and system. Another result is to show that a CBS is not just a list cost elements but a mean to identify all activities (and thus actors), products and resources involved in the management of a programme and the life of a system. The GCBS is a mean to integrate and organise all aspects of system life cycle.

The BCBS elaborate by the WG needs to be checked and experienced in national or multinational programmes. This exercise concerns not only the CBS but also considerations dealing with the uses of LCC and the associated definitions (LCC, TOC, COO and WLC). The conclusion of this experimentation could lead to improving the results presented in this report.

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Annex B – TERMS OF REFERENCE (TOR)

Task Group SAS-028 on Cost Structures and Life Cycle Costs for Military Systems

1.0 ORIGIN

1.1 Background

The LTSS/50 dealing with the life cycle cost (LCC) of all electric combat vehicles (AECV) mobility concludes that the lack of uniform approach in LCC area leads to potential underestimation's of future military peacetime expanses. This recognises that within NATO studies, particularly the LTSS50, there was a lack of common definitions and methodologies within the domain of Life Cycle Cost (LCC) analysis.

From this, the SAS Panel decided to establish the Exploratory Team SAS-E07 on Cost Structure and Life Cycle Cost for Military Systems to examine what could be done in respect to LCC issues and prepare a Terms of Reference (TOR) and Programme of Work (POW) for a possible new activity.

The Exploratory Team SAS-E07 proposed to start a new Task Group SAS-028 on the same subject which will be tasked to define and harmonise the basic and main concepts necessary to the implementation of LCC in military programmes.

1.2 Military Benefit

There is no direct military benefit accrued by undertaking this study. However it is viewed that this study could provide a mechanism which will enhance the procurement process where LCC is a constituent part of the decision making process. This will be accomplished by a reduction in study duration and an increase of consistency in LCC studies.

2.0 OBJECTIVES

2.1 Description of Area of Research

The cost items that constitute the LCC are defined and organised in a life cycle cost breakdown structure (LCCBS). Most Nations have their own LCCBS that is used for national programmes. In the same way, each national LCCBS refers to definitions that can be different from one country to another.

The primary area of research will concentrate on developing a generic life cycle cost breakdown structure (LCCBS) with associated definitions and an accompanying glossary of LCC terminology to support the LCCBS.

The definition of LCCBS constitutes the first stage in the modelling of LCC. Forecasting and analysis of LCC are however not limited with this only aspect. These activities involve methods and computational tools, data and databases, etc. The study will investigate the interest and the possibility to address these various aspects in a more general but concise guideline.

2.2 Scope

The study will primarily focus on LCCBS and terminology. It is envisaged that the study will provide guidance to LCC studies in the following areas:

a) Pan NATO procurement projects.

b) Multinational projects involving NATO members.

c) Research and Technology Board (RTB) studies, for example the LTSS/50.

d) Individual NATO members.

It is envisaged that the output from the study will not form part of any mandatory instructions on the use of a LCCBS, rather to provide guidance to Project Managers and LCC practitioners.

2.3 Goal

The main goal of the study is to develop a generic LCCBS, associated definitions and glossary of LCC and related items that will be of benefit to LCC studies.

The study will also investigate the interest and the possibility to develop a general but concise guideline addressing life cycle costing activities.

2.4 Deliverable

The final deliverable for the study will be a technical report containing guidance on the composition of a generic LCCBS and a glossary of LCC-related terminology. If a more general guideline is to be developed by the Technical Team, it will be included in the deliverable.

2.5 Symposium

To present the general findings of the study, SAS-028 will propose to task a new SAS Technical Team to organise a symposium open to Partners and NATO Countries and NATO Entities (working groups, organisations, office, etc.) interested by LCC.

2.6 Duration

The study will last 18 months.

3.0 RESOURCES

3.1 Membership

The Technical Team is open to all NATO countries for participation. It consists of nation representatives with special knowledge of LCC analysis and military systems. It is recognised that other specialists may be required in some areas, for instance Integrated Logistic Support (ILS) or military personnel.

France is the lead nation for this Technical Team.

3.2 Special Needs

None

4.0 SECURITY LEVEL

The development of a generic LCCBS and a glossary of LCC terminology is an unclassified activity. However, some working papers that can be classified up to NATO SECRET could be used punctually during certain meetings.

5.0 PfP NATIONS

PfP Nations will not participate to this study. However, they will be invited to attend the future symposium on the results of the task group.

6.0 LIAISON

Considering that LCC interests several NATO entities (working groups, organisations, office, etc.) whose activities are connected to this topic, SAS-028 will seek co-operation with them.

These Groups will be identified and contacted. The chairman of each interested Group will be invited to attend the first meeting of SAS-028 to advise on their involvement in LCC and propose possible contribution (documents) they could make. These documents will be added to the material provided by the Team members. It is not anticipated that those groups will participate in the following meetings of SAS-028, except if special needs occur.

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Annex C – PROGRAMME OF WORK

Task Group SAS-028 on Cost Structures and Life Cycle Costs for Military Systems

1.0 DESCRIPTION

The aim of the technical team is to develop a guide for the composition of a generic cost breakdown structure.

2.0 PRELIMINARY DEFINITIONS AND CONSIDERATIONS

Life cycle cost (LCC) represents all the costs that will be borne during the life of a System (Main System and Support System) to acquire, operate, support it and eventually dispose of it. The list of costs items to be considered in a project is defined and organised in a Life Cycle Cost Breakdown Structure (LCCBS).

Life cycle costing is a set of techniques for modelling, predicting and analysing the LCC of a system, at any stage of its life.

Life cycle costing (technical aspect) and its implementation in a national project (methodological aspect) are usually defined by national guidebook. To-date, such a guidebook is not available for multinational projects and particularly for those studies or projects involving NATO members.

In a multinational project, the first condition for a common approach is the use of common vocabulary and definitions, including a Cost Breakdown Structure. The primary task therefore of the Task Group will be to research the issues relating to a common cost breakdown structure, associated definitions and glossary. The team will generate an appropriate solution to this problem.

A related aspect with the LCCBS is that of methodologies or techniques used in deriving LCC estimates. Whilst it is recognised that this issue is not a primary objective in the work of the Task Group, due consideration should be given at the outset of the programme to the level of detail to which this aspect is to be considered.

3.0 MAJOR ITEMS OF WORK

In order to accomplish the objectives of the Task Group, the method of work will be divided into the following phases as described below:

a) **Review National Practice**. Each participating nation will review their own approaches to LCC and in particular the use of Cost Breakdown Structures. Where available it is expected that each nation will provide an indication of what they expect a generic LCCBS to comprise, definition of elements within the LCCBS and a glossary of terms used in LCC and/or related subjects.

   All material provided by NATO entities dealing with LCC will be added to national documents.

b) **Classification**. The Task Group will identify and classify differences between national practices.

c) **Resolution**. The Task Group will resolve differences between the definition of items identified above.

d) **Way Forward**. Study advantages and disadvantages of whether to specify a generic LCCBS or a generic method to derive a LCCBS. This decision will be aided by the information collated in previous items of work.

e) **Development**. Develop selected option and compile the glossary of LCC and related terms.

f) **Report**. Generate the final Report.

g) **Symposium**. Organise a symposium to present the general findings of the study.

4.0 SIGNIFICANT MILESTONES AND SCHEDULE

The Task Group will meet periodically to plan their necessary strategies on moving forward. Meetings should be held at least 3 times a year as a minimum. Meeting sites will rotate among the Task Group membership and will be called by the Task Group Chairman.

The following outline programme is proposed for the programme of work:

a) Initial meeting of the Task Group (January 2000).

b) Meeting 2: Review and compare National Practices (May 2000).

c) Chairman to identify and classify differences in National Practice and distribute results to the Task Group members.

d) Meeting 3: Resolution of defined differences and Way Forward (September 2000).

e) Chairman (plus other help as required) to develop outline solution and circulate to Task Group members.

f) Meeting 4: Further development and finalisation of selected option (January 2001).

g) Chairman to compile Report and circulate to Task Group.

h) Meeting 5: Finalise Report (March 2001).

i) Submission of Report to SAS Panel members (June 2001).

j) Organise a symposium to present the general findings of the study. This one-day symposium will be open to Partners Countries and NATO Entities interested by LCC: (September 2001, Brussels).

5.0 PARTICIPATING NATIONS

The following Nations have indicated a desire to participate: Belgium, Denmark, France, Germany, The Netherlands, Turkey and United Kingdom. Participation to the Task Group is open to any other NATO Nations.

6.0 NATIONAL CONTRIBUTIONS

Each participating nation will provide the manpower and information necessary to demonstrate national practice in LCC.

7.0 REPORT EDITING

The software packages to support the Task Group will be defined at the first meeting. The material will be provided in both paper copy and on magnetic media according to RTO procedures. The Task Group will examine problem of Copyright.

8.0 TECHNICAL TEAM ACTIVITY

Task Group SAS-028 will try to release a final report NATO unclassified unlimited and SAS panel will be invited to make this report open to Partners.

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Annex D – TAP

ACTIVITY	Task Group (TG)	Cost Structure and Life Cycle Costs for Military Systems												TBA	
PRIORITY	SAS-028													4/00	
PRINCIPAL MILITARY REQUIREMENTS		1	4											4/02	
MILITARY FUNCTIONS		1	4	9	10										
PANEL AND COORDINATION		Study Analysis and Simulation								SAS					
LOCATION AND DATES		Activities will be held in the participating countries													
PUBLICATION DATA		R						4/01				200			
KEYWORDS	Life Cycle Cost LCC	Cost Breakdown Structure						Production				Development			
		In-service costs													

1.0 THEME

The cost items that constitute the LCC are defined and organised in a life cycle cost breakdown structure (LCCBS). Most Nations have their own LCCBS that is used for national programmes. In the same way, each national LCCBS refers to definitions that can be different from one country to another.

The primary area of research will concentrate on developing a generic life cycle cost breakdown structure (LCCBS) with associated definitions and an accompanying glossary of LCC terminology to support the LCCBS.

The definition of LCCBS constitutes the first stage in the modelling of LCC. Forecasting and analysis of LCC are however not limited with this only aspect. These activities involve methods and computational tools, data and databases, etc. The study will investigate the interest and the possibility to address these various aspects in a more general but concise guideline.

2.0 JUSTIFICATION

The LTSS/50 dealing with the life cycle cost (LCC) of all electric combat vehicles (AECV) mobility concludes that the lack of uniform approach in LCC area leads to potential underestimation's of future military peacetime expenses. This recognises that within NATO studies, particularly the LTSS50, there was a lack of common definitions and methodologies within the domain of Life Cycle Cost (LCC) analysis.

From this, the SAS Panel decided to establish the Exploratory Team SAS-E07 on Cost Structure and Life Cycle Cost for Military Systems to examine what could be done in respect to LCC issues and prepare a Terms of Reference (TOR) and Programme of Work (POW) for a possible new activity.

The Exploratory Team SAS-E07 proposed to start a new Task Group SAS-028 on the same subject which will be tasked to define and harmonise the basic and main concepts necessary to the implementation of LCC in military programmes.

3.0 TOPICS TO BE COVERED

In order to accomplish the objectives of the Technical Team, the method of work will be divided into the following phases as described below:

1. Review National Practice: Each participating nation will review their own approaches to LCC and in particular the use of Cost Breakdown Structures. Where available it is expected that each nation will provide an indication of what they expect a generic LCCBS to comprise, definition of elements within the LCCBS and a glossary of terms used in LCC and/or related subjects.
2. Classification/Resolution: The Technical Team will identify, classify and resolve differences between national practices.
3. Way Forward: Study advantages and disadvantages of whether to specify a generic LCCBS or a generic method to derive a LCCBS.
4. Development: Develop selected option and compile the glossary of LCC and related terms.
5. The study will investigate the interest and the possibility to address other aspects of LCC in a more general but concise guideline.

CHAIRMAN/DIRECTOR/AUTHOR

G. Seguin, FR

MEMBERS/SPEAKERS

The six participating country representatives and other interested NATO member country representatives.

NATIONAL RESOURCES AVAILABLE

YES / TBD

Annex E – NATIONAL LCCBS

1.0 BE

1	**PROCUREMENT COST**
1.1	Material costs
1.1.1	Procurement costs
1.1.1.1	Of Costs of material
1.1.1.2	Of (Re-design) Cost adjustment/adaptation
1.1.2	Development costs
1.1.2.1	Costs of research
1.1.2.2	Design costs
1.1.2.3	Production and Fabrication costs
1.1.3	Procurement-insurance costs
1.2	Logistics support costs
1.2.1	Training costs
1.2.1.1	User training costs
1.2.1.1.1	Instructors costs
1.2.1.1.2	Simulators
1.2.1.1.3	Training means
1.2.1.1.4	Training materiel
1.2.1.2	Training costs support personnel
1.2.1.2.1	Instructors costs
1.2.1.2.2	Training means
1.2.1.2.3	Training material
1.2.2	Spare parts costs
1.2.3	Measurement-and testing equipment costs
1.2.4	Tool costs
1.2.5	Documentation costs
1.2.5.1	Users documentation costs
1.2.5.2	Support / Maintenance documentation costs
1.2.6	Information documentation costs
1.2.7	Infrastructure costs
1.2.7.1	Buildings
1.2.7.1.1	Costs of news buildings
1.2.7.1.2	Adaptation costs of existing buildings
1.2.7.1	Work
1.2.7.2.1	Costs of new buildings
1.2.7.2.2	Adaptation costs of existing buildings
1.2.7.3	Ground
1.2.7.3.1	Costs of new buildings
1.2.7.3.2	Adaptation costs of existing buildings
1.2.8	Transportation costs
1.2.9	Consumption goods costs
1.3	Preparation costs
1.3.1	Testing costs
1.3.1.1	Prototypes
1.3.1.2	Logistic support costs
1.3.1.3	Exploitation costs
1.3.1.3.1	Costs of personnel

1.3.1.3.2	Consumption goods costs
1.3.1.3.3	Outsourcing costs
1.3.1.4	Management costs of the testing
1.3.2	Project costs
1.3.2.1	Purchase costs
1.3.2.2	Configuration management costs
1.3.2.3	Outsourcing costs
1.3.3	Importation costs
1.3.3.1	Transportation - and distribution costs
1.3.3.2	Installation costs
1.4	Others costs
2	**EXPLOITATION COST**
2.1	Cost of use
2.1	Personnel costs
2.1.1	Training costs manipulators
2.1.2.1	Instructor costs
2.1.2.2	Simulators
2.1.2.3	Training means
2.1.2.4	Training material
2.1.3	Users documentation costs
2.1.4	Infrastructure costs for the use of material
2.1.4.1	Building
2.1.4.1.1	Manipulation-and support costs
2.1.4.1.2	Periodical depreciation costs of old buildings
2.1.4.2	Work
2.1.4.2.1	Manipulation-and support costs
2.1.4.2.2	Periodical depreciation costs of old buildings
2.1.4.3	Ground
2.1.4.3.1	Manipulation-and support costs
2.1.4.3.2	Periodical depreciation costs of old buildings
2.1.5	Consumption goods costs
2.1.5.1	Fuel costs
2.1.5.2	Munitions costs
2.1.5.3	Other consumption costs
2.2	Maintenance costs
2.2.1	Maintenance personnel costs
2.2.2	Maintenance personnel training costs
2.2.2.1	Instructors costs
2.2.2.2	Training means
2.2.2.3	Training material
2.2.3	Spare parts costs
2.2.4	Inventory costs
2.2.5	Measurement-and testing equipment costs
2.2.6	Tool cost
2.2.7	Maintenance documentation costs
2.2.8	Information documentation costs
2.2.9	Infrastructure costs for the use of material
2.2.9.1	Building
2.2.9.1.1	Manipulation-and support costs
2.2.9.1.2	Periodical depreciation costs of old buildings

2.2.9.2	Work
2.2.9.2.1	Manipulation-and support costs
2.2.9.2.2	Periodical depreciation costs of old buildings
2.2.9.3	Ground
2.2.9.3.1	Manipulation-and support costs
2.2.9.3.2	Periodical depreciation costs of old buildings
2.2.10	Transportation costs
2.2.10.1	Material
2.2.10.2	Spare parts / Reparation tools
2.2.11	Maintenance outsourcing costs
2.2.12	Modification/Upgrading costs
3	**REMOVAL COSTS**
3.1	Material costs
3.1.1	Residual value
3.1.2	Relived costs
3.1.3	Destruction costs
3.2	Logistic support costs
3.2.1	Residual value
3.2.1.1	Infrastructure
3.2.1.2	Other Logistic support elements
3.2.2	Removal cost
3.2.3	Destruction costs

2.0 FR

0	0	0	0	**DEFINITION OF NEED**
1	0	0	0	**OPTIMISATION stage**
1	**1**	0	0	**Project management**
1	**2**	0	0	**Feasibility**
1	2	1	0	Studies
1	2	3	0	Mock-up manufacture
1	2	4	0	Tests & evaluations
1	**3**	0	0	**Definition**
1	3	1	0	Studies
1	3	3	0	Demonstrators manufacture
1	3	4	0	Tests
1	3	6	0	Definition changes
2	0	0	0	**ACHIEVEMENT stage**
2	**1**	0	0	**Project management**
2	**4**	0	0	**Development**
2	4	0	100	Main system
2	4	1	100	Studies
2	4	3	100	Prototype manufacture
2	4	4	100	Qualification tests
2	4	5	100	Production investment
2	4	0	200	Support elements
2	4		201	Data & documentation
2	4		204	Support equipment
2	4		205	Packaging, handling, storage and transport means (PHST)
2	4		206	Training courses and equipment

2	4		211	Infrastructures
2	4	0	300	GFF development
2	4	6	0	Development changes
2	**5**	0	0	**Production**
2	5	0	100	Main system
2	5	2	100	GFE
2	5	3	100	Manufacture
2	5	4	100	Contractor acceptance tests
2	5	8	100	Integration
2	5	0	200	Support elements
2	5	0	201	Maintenance plan
2	5	0	202	Data & documentation
2	5	0	203	Spares
2	5	0	204	Support equipment
2	5	0	205	Packaging, handling, storage and transport means
2	5	0	206	Training courses and equipment
2	5	0	207	Computer means
2	5	0	208	Staff support means
2	5	0	209	Technical operational use means
2	5	0	210	Support follow-up means
2	5	0	211	Infrastructures
2	5	0	300	GFF manufacture or modification
2	5	6	0	Modifications after fielding
2	**6**			**GFF utilisation**
2	**7**	0		**Fielding**
2	7	7		Packaging, handling, storage and transport
2	7	8		On site integration
2	7	4		On site acceptance tests
2	7	9		Initial training
3				**IN SERVICE Stage**
3	**1**			**Management**
3	**2**			**Operation**
3	2	0	1	Personnel
3	2	0	2	POL / energy
3	2	0	3	Consumables
3	2	0	4	Means
3	2	0	5	Transportation
3	2	0	6	Staff support
3	2	0	7	Munitions
3	2	0	11	Others
3	**3**			**Support**
3	3	**1**		**Maintenance**
3	3	1	1	Personnel
3	3	1	2	POL / Energy
3	3	1	3	Consumables
3	3	1	4	Means
3	3	1	5	Transportation
3	3	1	8	Contractor assistance or sub-contract
3	3	**2**		**Replenishment spares**
3	3	2	1	Personnel
3	3	2	5	Transportation
3	3	2	9	Non repairable spares

3	3	2	10	Repairable spares
3	3	**3**		**Software maintenance**
3	3	3	1	Personnel
3	3	3	4	Means
3	3	3	8	Contractor assistance or sub-contract
3	3	**4**		**Ongoing training**
3	3	4	1	Personnel
3	3	4	3	Consumable
3	3	4	4	Training means
3	3	4	6	Allowances
3	3	4	8	Contractor assistance
3	3	**5**		**Infrastructure**
3	3	5	1	Personnel
3	3	5	2	Energy
3	3	5	3	Consumable
3	3	5	8	Private contract
3	3	**6**		**Technical follow-up**
3	3	6	1	Personnel
3	3	6	4	Means
3	3	6	8	Contractor assistance
4	0	0	0	**DISPOSAL**
4	0	0	0	
4	0	0	0	

3.0 NL

1	**PROCUREMENT**
1.1	Procurement or development
1.2	Initial logistic support
1.3	Preparation
1.3.1	Testing and acceptance
1.3.2	Installation
1.3.3	Project
1.4	Other procurement
2	**EXPLOITATION**
2.1	Operation
2.1.1	Personnel
2.1.2	Training
2.1.3	Documentation
2.1.4	Infrastructure/Facilities
2.1.5	Consumables
2.1.6	Others
2.2	Support
2.2.1	Personnel
2.2.2	Training
2.2.3	Facilities
2.2.4	Spare/repair parts
2.2.5	Test & support
2.2.6	Documentation
2.2.7	Computer resources

2.2.8 Infrastructure
2.2.9 PHST
2.2.10 Contracting out maintenance
2.2.11 Modification/Upgrading
3 **DISPOSAL**
3.1 Materiel
3.2 Support elements

4.0 UK

00 **00-19 Risk Reduction Studies, Development, Test & Evaluation**
01 Project / Programme Management
02 System Engineering
03 Design & Development Engineering
04 Development Investment
05 Prototype Manufacture
06 Test & Evaluation
07 Training Development
08 Publications Development & Data Packs
09 Intellectual Property
10 Government Furnished X
11 Technology Evaluation
12 Health & Safety
13 Trials & Demonstration
14 Integrated Logistic Support
15 Software
16 Synthetic Environments
17 Continuing Design Support
18 Studies
19 Spare
20 **20 - 39 Equipment Procurement**
21 Project / Programme Management
22 System Engineering
23 Engineering Changes
24 Production Investment
25 Production
26 Test & Evaluation
27 Training
28 Publications & Data Packs
29 Integration
30 Government Furnished X
31 Special To Type Test Equipment
32 Fielding
33 Modifications resulting from first fielding
34 Health & Safety
35 IS/IT (deliverables including MIS)
36 Integrated Logistic Support
37 PPP/PFI Service provision
38 Synthetic Environments
39 Acceptance Testing & reliability trials

40	**40 - 49 Infrastructure modification (resulting from equipment purchase)**
41	Development
42	Construction
43-49	Spare
50	**50-69 Operation**
51	Crew
52	Consumables
53	Munitions (training & replenishment)
54	Transport
55-69	Spare
70	**70-84 In-Service Support**
71	Support Management
72	Upkeep - planned (preventative maintenance) including refits
73	Upkeep - unplanned (corrective maintenance)
74	Replenishment Spares
75	Depot/Storage
76	Training (ongoing provision)
77	Transportation of equipment
78	Overhaul
79	Upgrade capability
80	Post Design Support
81	Contractor Logistic Support
82	Support equipment & STTE
83	Technical data maintenance
84	Spare
85	**85-89 Attrition**
85	Loss of Capability
86 -89	Spare
90	**90-94 Infrastructure Maintenance/Management**
91	Management of infrastructure that is required as a result of equipment ownership
92	Maintenance of infrastructure that is required as a result of equipment ownership
93	Spare
94	**94-97 Disposal/ Demilitarisation**
94	Storage and Disposal
95	Environmental aspects
96	Sales Revenue **
97	Spare
98	**98-99 Environmental (demilitarisation covered above)**
98	Compliance, plans etc.
99	Measures

5.0 US

1	**RESEARCH AND DEVELOPMENT**
1.1	Concept exploration/definition
1.2	Demonstration/Validation
1.3	Engineering and manufacturing development
1.3.1	Prime Mission Equipment
1.3.1.1	Structure, Integration, Assembly, Test and Checkout
1.3.1.2	Propulsion

1.3.1.3	Installed Equipment (hardware/software) (Specify)
1.3.1.4	System and Application Software (where applicable)
1.3.2	System Test and Evaluation
1.3.3	System Engineering/Programme Management
	Flyaway Cost
1.3.4	Support Equipment (Peculiar and Common)
1.3.5	Training
1.3.6	Data
1.3.7	Initial Spares and Repair Parts
1.3.8	Operational/Site Activation
1.3.9	Industrial Facilities
1.3.10	In-house (Specify)
1.3.11	Contingency/Risk Factor
1.3.12	Other
2	**INVESTMENT** (Production and deployment phase)
2.1	Prime Mission Equipment
2.1.1	Structure, Integration, Assembly Test and Checkout
2.1.2	Propulsion
2.1.3	Installed Equipment (hardware/software) (Specify)
2.1.4	System and Application Software (where applicable)
2.2	System Engineering/Programme Management
	Flyaway Cost
2.3	Command and Launch Equipment (Specify)
2.4	Platform Modification (Specify)
2.5	Support Equipment (Peculiar and Common)
2.6	Training
2.7	Data
2.8	Operational/Site Activation
2.9	Industrial Facilities
2.10	Initial Spares and Repair Parts
2.11	Other Procurement
3	**OPERATING AND SUPPORT**
3.1	Mission Personnel Pay and Allowances
3.1.1	Operations
3.1.2	Maintenance
3.1.3	Other Mission Personnel
3.2	Unit Level Consumption
3.2.1	Petroleum, Oil and Lubricants (POL)/Energy Consumption
3.2.2	Consumable Material/Repair Parts
3.2.3	Depot Level Reparable
3.2.4	Training Munitions/Expendable Stores
3.2.5	Other
3.3	Intermediate Maintenance (External to Unit)
3.3.1	Maintenance
3.3.2	Consumable Material/Repair Parts
3.3.3	Other
3.4	Depot Maintenance
3.4.1	Overhaul/Rework
3.4.2	Other
3.5	Contractor Support
3.5.1	Interim Contractor Support (ICS)
3.5.2	Contractor Logistics Support

3.5.3	Other
3.6	Sustaining Support
3.6.1	Support Equipment Replacement
3.6.2	Modification Kit Procurement/Installation
3.6.3	Other Recurring Investment
3.6.4	Sustaining Engineering Support
3.6.5	Software Maintenance/Support
3.6.6	Simulator Operations
3.6.7	Other
3.7	Indirect Support
3.7.1	Personnel Support
3.7.2	Installation Support

6.0 TU

1	**DEVELOPMENT**
1.1	Conceptual phase
1.2	Demonstration/validation/advanced development phase
1.3	Full-scale development phase
1.3.1	Programme management
1.3.2	Engineering
1.3.3	Fabrication development tests
1.3.4	Development tests
1.3.5	Test and evaluation support
1.3.6	Data
1.3.7	Producibility engineering & planning
2	**PRODUCTION** phase/investment
2.1	Non-recurring investment
2.1.1	Programme management
2.1.2	Producibility engineering & planning
2.1.3	Initial production facilities
2.1.4	Initial spares and repair parts
2.1.5	Common support equipment
2.1.6	Peculiar support equipment
2.1.7	Data
2.1.8	Initial training
2.1.9	Technical support
2.2	Recurring investment
2.2.1	Labour
2.2.2	Material
2.2.3	Sustaining engineering
2.2.4	Quality control and inspection
2.2.5	Packaging and transportation
2.2.6	Operational site activation
3	**OPERATION and SUPPORT**
3.1	Operation
3.1.1	Electric power
3.1.2	Consumables
3.1.3	Operational personnel
3.1.4	Operational facilities

3.1.5 Leasing
3.2 Support
3.2.1 System equipment maintenance
3.2.2 Support equipment maintenance
3.2.3 Contractor services
3.2.4 Inventory administration
3.2.5 Replenishment spares & repair parts
3.2.6 Repair material
3.2.7 Transportation and packaging

Annex F – COMPARISON OF NATIONAL LCCBS

	USA	UK	FR	NL	B	Blanchard	TU	GE
Procurement Phase								
Procurement Costs					1			
Procurement Cost of (sub)Systems				2.1.1	1.1.1.1			1.1 + 2.1 + 3.2
Hardware Procurement								1.1.1
Software Procurement								1.1.2
R&D			1.0.0	2.1.2.1	1.1.2.1	R		
Programme Management		01	1.1.0	2.3.2	1.3.2	RM	1.3.1	1.2 + 2.2 + 3.3
Feasibility Phase	1.1	02	1.2.0			RR	1.1	
Studies			1.2.1					1.8 + 2.8 + 3.9
Models Manufacture			1.2.3					
Tests			1.2.4					
Quality Assurance								1.3 + 2.3 + 3.4
Definition	1.2	03	1.3.0					2
Engineering Design			1.3.1 + 2.4.1	2.1.2.2	1.1.2.2	RE	1.3	
System Engineering						REx	1.3.2	2.11
Electrical Design						REx		
Mechanical Design						REx		
Reliability						REx		
Maintainability						REx		
Human Factors						REx		
Producibility						REx	1.3.7	
Logistic Support Analysis		14				REx		

	USA	UK	FR	NL	B	Blanchard	TU	GE
Development	1.3					RT	1.2	
Programme Management	1.3.3							
Development Investment		04						
Tooling		04.01						
Facilities	1.3.9	04.02						
Models		04.03						
Prototype Fabrication	1.3.1	05	1.3.3 + 2.4.3			RDL		2.9 + 3.10
Prototype Material						RDM		
Test Operations and Support	1.3.2	06 + 13	1.3.4			RDT		2.12 + 3.13
Fabrication Development Tests							1.3.3	
Development Tests							1.3.4	
Test and Evaluation Support							1.3.5	
Support Equipment	1.3.4							
Training Development	1.3.5	07						
Studies, Definition and Design Changes		17 + 18	1.3.6					
Documentation and Data Packs	1.3.6	08				RD	2.1.7	
Initial Spares and Repair Parts	1.3.7							
Operational/Site Activation	1.3.8							
Intellectual Property/Technology Evaluation		09 + 11						
Government Furnished	1.3.10							
Equipment		10.01						
Facilities		10.02						
Information		10.03						
Resources		10.04						
Contingency/Risk Factor	1.3.11							
Health and Safety		12						
Software		15						
Synthetic Environments		16						

	USA	UK	FR	NL	B	Blanchard	TU	GE
Investment	2		2.0.0			I	2	
Production or Manufacturing				2.1.2.3	1.1.2.3	IM		
Nonrecurring Manufacturing						IN	2.1	
Manufacturing Engineering		22	2.4.0			INM	2.1.2	
Tools and Equipment		24.01	2.4.5			INT		
Quality Assurance		25.03				INA	incl. in 2.2.4	
Manufacturing Management	2.2	21	2.1.0			INP	2.1.1	
Qualification Test			2.4.4			INQ	incl. in 2.1.9	
Production Sampling Test		24.03				INS	incl. in 2.1.9	
Development Changes	2.4	23	2.4.6					
Recurring Manufacturing			2.5.0			IR	2.2	
Recurring Manufacturing Engineering Support						IRE	2.2.3	
Production Fabrication and Assembly Labour	2.1	25.01	2.5.3 + 2.5.8			IRL	2.2.1	
Production Material and Inventory			2.5.2			IRM	2.2.2	
Inspection and Test		26	2.5.4			IRI	incl. in 2.2.4	
Packaging and Initial Transportation			incl. in 2.7.7	incl. in 2.3.3.1	incl. in 1.3.3.1	IRT	2.2.5	
Sustain Tooling		25.02						
Command and Launch Equipment	2.3							
Government Furnished								
Equipment		30.01						
Facilities		30.02						
Information		30.03						
Resources		30.04						

	USA	UK	FR	NL	B	Blanchard	TU	GE
Fielding			2.7.0					
On-site Integration	2.8	29	2.7.8	2.3.3.2	1.3.3.2			
On-site Acceptance Tests		39	2.7.4	2.3.1	1.3.1			
Modifications from First Fielding		33						
Facilities				2.2.6	1.2.7	IC		
Manufacturing Facilities	2.9	24.02				ICP	2.1.3	
Test Facilities						ICT		
Operational Facilities		41 + 42				ICO	incl. in 2.2.6	
Maintenance Facilities						ICM	incl. in 2.2.6	
Health and Safety		34						
Private/Public/Partnerships Services		37						
Synthetic Environments		38						
Initial Logistic Support				2.2	1.2	IL		1.4 + 2.4 + 3.5
Logistic Programme Management		36				ILM		
Provisioning						ILP		
Initial Spare/Repair Parts	2.10	32.01 + 32.02		2.2.2	1.2.2	ILS	2.1.4	
Initial Inventory Management						ILI		
Technical Data Preparation		28		2.2.4	1.2.5	ILD		
Initial Training and Training Equipment	2.6	27	2.7.9	2.2.1	1.2.1	ILT	2.1.8	1.4.2
Initial Test and Support Equipment	2.5			2.2.3	1.2.3 + 1.2.4	ILX		
Common Support Equipment		32.03 + 32.07					2.1.5	
Peculiar Support Equipment		31					2.1.6	

	USA	UK	FR	NL	B	Blanchard	TU	GE
First Destination Transportation		32.04	incl. in 2.7.7	incl. in 2.3.3.1	incl. in 1.3.3.1	ILY		
Procurement Hard- and Software Logistic Information Systems	2.7	35		2.2.5	1.2.6			
Means of Transport				2.2.7	1.2.8			
Initial Supplies of Consumable Goods				2.2.8	1.2.9			
Fuel, Oil and Lubricants				2.2.8x				
Ammunition		32.05 + 32.06		2.2.8x				
Consumables for Maintenance				2.2.8x				
Insurance Costs				2.1.3	1.1.3			
In-service Phase		5			2			
Operation & Support			3			O	3	
Management		71	3.1.0					
Mission Personnel	3.1							
Operations	3.1.1	51.01 + 51.03	3.2.0.1	3.1		OO		
Pay and Allowances				3.1.1	2.1.1	OOP	3.1.3	deels 3.2.1.1
Documentation				3.1.3	2.1.3			
Maintenance	3.1.2	72 + 73	3.3.1.1			OM		
Pay and Allowances				3.2.1.1	2.2.1	OMM	incl. in 3.2.1	3.2.1.2 + 3.2.2.3 + 3.2.2
Documentation		83		3.2.6	2.2.7			
Other Mission Personnel	3.1.3							
Operations Consumables	3.2							
POL/Energy Consumption	3.2.1	52.01	3.2.0.2 + 3.3.1.2	3.1.5.1 + 3.1.5.2	2.1.5.1		3.1.1 + 3.1.2	deels 3.2.1.1

	USA	UK	FR	NL	B	Blanchard	TU	GE
Training Munitions/Expendable Stores	3.2.2		3.2.0.7	3.1.5.3	2.1.5.2			
Papers, Batteries etc.			3.2.0.3					
Other	3.2.3		3.2.0.11		2.1.5.3			3.2.2.6
Command and Control								3.2.2.5
Spares and Repairs	3.3					OMX		
Consumable Material	3.3.1	52.02	3.3.1.3	3.1.5.4		SC	3.2.6	
Replenishment Spare Parts	incl. in 3.3.1	74	3.3.2.1 + 3.3.2.9 + 3.3.2.10			SO + SI	3.2.5	
Depot Level Repairable	3.3.2		incl. in 3.3.2.10	3.2.3	2.2.3	SD	incl. in 3.2.1	
External Maintenance	3.3.3			3.2.10	2.2.11	SS	incl. in 3.2.3	3.1.1.1 + 3.1.1.2
Depot Maintenance	3.3.4	78		3.2.1.2				
Contractor Support	3.3.5	81	3.3.1.8				3.2.3	3.1.1.3 + 3.1.1.4 + 3.1.1.6
Infrastructure	3.4	91 + 92	3.3.5					3.5.2
Cost Infrastructure for Operations				3.1.4	2.1.4	OOF	3.1.4	
Cost Infrastructure for Maintenance				3.2.8	2.2.9			
Indirect Support								
Personnel Support (Training)	3.4.1	51.02 + 76	3.3.4	3.1.2 + 3.2.2	2.1.2 + 2.2.2			3.1.1.5 + 3.2.3.1 + 3.2.3.2
Training Operating Personnel						OOT	incl. in 3.1.3	
Training Support Personnel						OMP		
Installation Support	3.4.2							
External Services			3.3.6					3.3 + 3.6

	USA	UK	FR	NL	B	Blanchard	TU	GE
PHST	3.5	54 + 75 + 77	3.2.0.5 + 3.3.1.5 + 3.3.2.5	3.1.6 + 3.2.4 + 3.2.9	2.2.4 + 2.2.10	OMT	3.2.4 + 3.2.7	3.2.1.3 + 3.2.2.3 + 3.2.2.4
Sustaining Support								
Support Equipment Maintenance & Replacement	3.6.1	82	3.3.1.4	3.2.5	2.2.5 + 2.2.6	OOE + OMS	3.1.5 + 3.2.2	
Mod Kit Procurement/Installation	3.6.2	79.01 + 80	2.5.6	3.2.11	2.2.12	ON		3.4.1 + 3.4.2
Other Recurring Investment	3.6.3							3.5.1
Sustaining Engineering Support	3.6.4							
Software Maintenance Support	3.6.5	79.02	3.3.3	3.2.7	2.2.8	OMD		
Simulator Operations	3.6.6		incl. in 3.2.0.4 en 3.3.4					
Staff Support			3.2.0.6					
Other	3.6.7							
Attrition								
Loss of Capability		85						
Disposal	4		4	4	3	OP		3.7
Retail Price (sub)Systems (Neg.)		96		4.1	3.1.1			
Dismantle or Destruct (sub)Systems		94 + 95 + 98 + 99		4.2	3.1.2 + 3.1.3			
Retail Price Log. Support Elements (Neg.)				4.3	3.2.1			
Destruct Log. Support Elements				4.4	3.2.2 + 3.2.3			
Disposal of Obsolete Ammunition				4.5				

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Annex G – CLASSIFICATION OF COSTS

1.0 LINKED AND NON-LINKED COSTS

Linked costs refer to activities or resources that can be associated to the procurement, operation, support and disposal of the system. Examples of these costs include items such as operation, system specific training.

Conversely, non-linked costs cannot be readily associated to the system. Examples of these costs include items such as family housing, medical services, ceremonial units, basic general training (not related to a specific equipment), headquarters and staff, academies, recruiters, etc.

2.0 DIRECT AND INDIRECT COSTS

It is not always evident whether certain cost should be classified as direct or indirect. To help classifying these costs, the following definitions are proposed.

A direct cost	refers to an activity or a resource	that can be easily allocated (without ambiguity and intermediate analysis) to a product
An indirect cost		associated to several products. It must be shared (apportioned) between those products before being attributed to each one

When an activity or a resource is unique to the product, its cost is direct.

When an activity or a resource relates to several products, its cost may be direct or indirect.

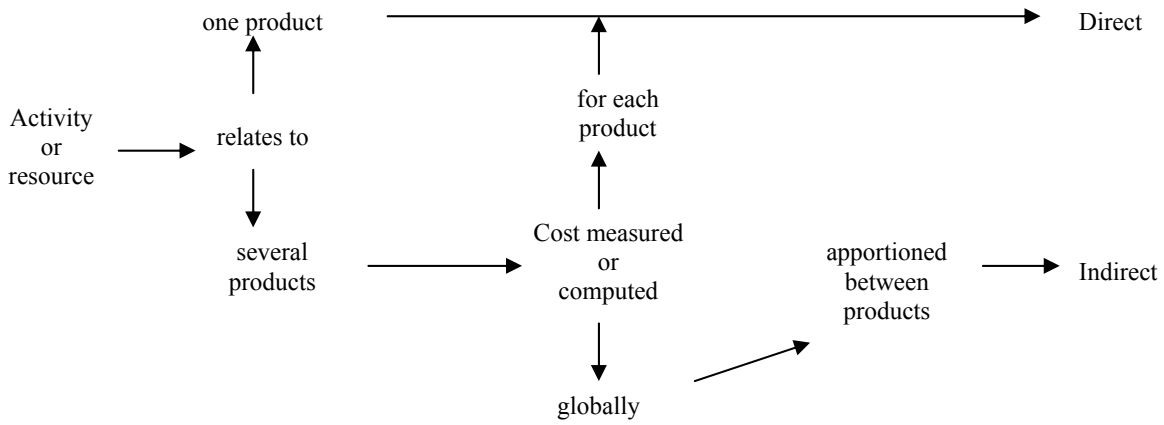
> It is direct when the share attributable to each product is measured directly. In the other case, the total cost of the activity or the resource is spread out between the products using a key.

In fact, classifying a cost as direct or indirect depends mainly upon the ability of the organisation to measure the share allocated to each product (accounting system).

Example

> Direct material refers to all material costs that are used in making a product. It includes raw materials, purchased parts, and subcontracted items required to manufacturing and assembling completed products. The ease with which direct material can be traced to the final product has a great deal to do with whether the material is considered as direct material. For example, miscellaneous small parts used in manufacturing aircraft may be considered too small and too inexpensive to justify either the cost or time required to keeping track of their cost applicable to specific aircraft. For practical reasons, they may be classified as an indirect expense.

Previous definitions are illustrated by the following figure.



It is important to keep in mind that the methods used to classify direct and indirect costs by individual organisations may be very different.

3.0 VARIABLE AND FIXED COSTS

The various indirect costs do not behave in the same way with the introduction of a new system. Some indirect costs may increase while others remain unchanged. There are two broad categories of costs based upon the criteria of behaviour over business volume: variable and fixed costs.

Variable costs are those which are affected by, and therefore vary because of, the existence of the system. A variable cost fluctuates proportionally or not (**semivariable**) with a characteristic of the system (production volume, level of services provided).

Fixed costs do not vary because of the existence of the system. Associated to the organisation rather than the sole system, they are relatively constant within a range of time or volume. Fixed costs may be referred to as discretionary costs, indicating that control over these expenses rests with top management rather than with project managers.

A large number of expenses contain both fixed and variable components. These expenses often remain relatively fixed between various ranges of volumes and then advance or decline in a **step-type function** as volume changes occurs (organisational or multiple programme effects).

Remark

If the previous definitions apply for a system considered as a whole, variable and fixed costs categories can also be defined on a relative basis. For example when comparing two maintenance policies of a given system, all cost elements that are independent of the maintenance do not vary between the two solutions. They are considered as fixed cost in the framework of the comparison between two options.

4.0 ASSETS VERSUS EXPENSES

The total cost of items that are acquired for relatively small amounts for general purpose use are usually classified as expenses and are placed into indirect costs pools for subsequent allocation to many systems or contracts.

An asset (or capitalised item) is a valuable item that is owned or controlled by an organisation. In each subsequent accounting period when the item is put into use, an appropriate portion of its cost is written off

as an expense based on the estimated service life of the item. This expense is called depreciation (or amortisation) and represents the systematic allocation of the cost of the asset over its estimated useful life. It also represents the decline in useful value of the asset, due to wear and tear from use and passage of time.

5.0 OPPORTUNITY COSTS

Opportunity costs relate to the value of assets or resources that are used in the programme but could be deployed elsewhere or sold. This 'opportunity lost' is often included in economic appraisals.

6.0 SUNK COSTS

Sunk costs are the cost of resources already spent or committed. Sunk costs will not affect the choice between alternative options in economic analysis. They are costs that have been created by a decision made in the past and that cannot be changed by any decision that will be made in the future.

7.0 EXAMPLE OF QUESTIONS/ANSWERS

In this paragraph the different cost categories are explained with examples.

1. The product of a programme A includes the main system A and a test equipment TE used for the maintenance of A.

   Costs of TE are allocated to system A as direct costs.

2. Later on, a new system B uses for its maintenance the test equipment TE already existing in the organisation an common with system A. No additional TE is required due to the introduction of this new system B.

   Costs of TE[1] are allocated to B as indirect-fixed costs. The share allocated to B is removed from system A[2].

3. The new system B uses for its maintenance the test equipment TE already existing in the organisation an common with system A. One additional piece of TE is required due to the introduction of this new system B.

   Costs of the additional piece of TE are allocated to B as direct for procurement and indirect-variable costs for O&S.

4. Maintenance of system A is performed at intermediate level by maintainers who work only for this system.

   Associated labour costs are direct costs. Those costs are assessed on the basis of the number of persons dedicated to the maintenance and not the workload.

[1] Except sunk costs (all costs spent for TE before the introduction of system B).

[2] This is true when considering TOC or WLC (see § 2). When considering LCC where fixed costs are not considered, LCC of B does not include TE costs and LCC of A remains unchanged.

5. Those maintainers at intermediate level perform the maintenance of both systems A and B.

   Associated labour costs are direct costs for A and B. This is based on the assumption that the time dedicated to the maintenance can be measured separately for each system. Those costs are assessed on the basis of the workload generated by each system.

6. In example 5, foremen are in charge of planning and inspecting the work performed by maintainers.

   Associated labour costs are indirect costs for A and B. They can be assessed on the basis of an equal share between A and B or of the workload generated by each system.

7. Non-linked costs cannot be direct, so non-linked costs are always indirect. The non-linked (indirect) costs cannot be readily associated to the new system. An example of non-linked fixed is the management or the headquarters. But if, as a result of the procurement the headquarters has to be extended, e.g. with new recruiters that will recruit new personnel, the costs for this extension can be considered as a non-linked indirect variable cost.

Annex H – PRODUCTS AND RESOURCES

Identification of the elements of the Product Tree (PT) is an important stage in the development of a CBS, for these elements and the costs they induce will be considered individually over the system life cycle. A product element is usually developed, produced (or modified in the case of pre-existent elements), operated and supported over its life cycle. Each product element may have its own LCC.

On the other hand, the PT may not necessarily contain all elements involved during the life of the system. Some of these elements can be regarded as resources used by certain activities. Their existence is then transitory.

Example

Let S and C be two pieces of support equipment used for maintenance. S is a support equipment specific to the system whereas C is common to other systems and thus pre-existent in the organisation. The representations of S and C will be different in the system CBS.

Extract of CBS where S appears	Extract of CBS where C appears
Development of S	Maintenance of the Main System
Production of S	Resources
Operation of S	Personnel
Support of S	Consumable
Disposal of S	Support equipment C

S is an element of the product tree to which a LCC may be allocated. C is a resource used for the maintenance of the main system. LCC of equipment C is not relevant. The only relevant information is the cost contribution, if any, allocated to the system when using C as a resource for the maintenance.

This distinction can be extended to any element of the product tree and even (theoretically) to the main system if it is planned to rent this system when needed. In this case, the system is a resource required to complete a mission. In practice, mainly support elements and specific means are concerned.

The rule to be applied for considering an element as a product or a resource can be defined in the following way:

Product — Costs associated to the element are direct-variable[1]

Resource — Costs associated to the element are either fixed or indirect[1]

Examples

a) A test equipment specific to the system is necessarily new in the organisation. Associated costs are variable (generated by the existence of the system) and direct (can be easily allocated to the system). This test equipment is a product (a support element) of the project.

b) A test equipment TE, common to others systems, will be used by the new system. If the existence of the system increases the burden of TE, it does not increase the number of units of this test equipment. Even if in-service cost of TE increases (in which case it is variable), it will probably be considered as indirect cost apportioned between users. This test equipment is a resource used for the maintenance of the system.

[1] See Annex G.

c) A storage facility, common to other systems, and undergoing no changes because of the existence of the new system is a resources as associated costs are fixes and indirect.

d) A testing facility has undergone important changes for the production of a new system. Associated costs are variable (generated by the existence of the system) and direct (can be easily allocated to the system). The testing facility is a product to be included in specific means.

Remarks

This rules applies only for resources that could be considered as product elements. For example it doesn't apply to personnel or services.

An element may be considered both as product and resource at different times in the system life cycle. This is the case of a support equipment, common to other systems, but for which an additional unit must be bought because of the introduction of the new system[2]. This support equipment is considered as a product for procurement costs and a resource for in-service costs.

[2] The additional burden of the support equipment makes it necessary to increase the number of units of this equipment. However, all units of this support equipment will be used by any systems.

Annex I – LIST OF ACTIVITIES

01	Management	
02	Studies, A&S	
	Main system	
	HW	
	SW	
	Support system	
	Specific means	
03	Engineering	
	Main system	
	HW	
	SW	
	Support system	
	Specific means	
04	Purchase	
	Main system	
	HW	
	SW	
	Support system	
	Specific means	
05	Manufacturing	
	Main system	
	Support system	
	Specific means	
06	Integration	
	Main system	
	HW	
	SW	
	Support system	
---	---	
14	Operation	
14-01	Main system	
14-01-01	Personnel	(Cost of personnel to operate the main system)
14-01-02	Consumables	
14-01-03	Infrastructure	
14-01-04	Services	
14-02	Support system	
14-03	Specific means	
15	Maintenance	
	Main system	
	HW	
	Personnel	(Cost of personnel to maintain main system HW)
	Consumables	
	Infrastructure	
	Services	
	SW	
	Support system	
	Specific means	

16 Replenishment
- Main system
- Support system
- Specific means

17 Disposal

Annex J – LIST OF CBS ACTIVITIES

PROCUREMENT

Management

Studies, Analyses and Simulation

Engineering

- System Engineering
- Design and Development Engineering
- Design Changes

Purchase off the Shelf (Government or Commercial)

Investment

- Tooling
- Facilities
- Reference Sets

Manufacturing

Systems Integration

System Level Test, Evaluation, Trials and Demonstration

Deployment

- Delivery (PHST)
- Training
- Installation
- Acceptance Testing

Other

IN SERVICE

Operation

Mission Support

Maintenance

Replenishment

Continuation Training

PHST

Sustaining Support

- Modification Kit Procurement/Installation
- Sustaining Engineering Support
- Software Maintenance Support
- Other

Restoration

Other

Disposal

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Annex K – EXAMPLE OF CBS (TABLE)

	Main System	Support elements					
		Data & Doc	Spares	Support equip.	PHST means	Training means	Infra.
Feasibility							
Management	Usually considered at the level of the project						
Studies							
Others							
Project Definition							
Management							
…							
Design & development							
Management							
…							
Investment							
Others							
Production							
Management							
Studies							
Investment							
Purchase off the shelf							
Manufacturing							
…							
Deployment							
O&S							
Operation		Operating costs refer only to the main system (MS). Costs generated when operating support elements are usually included in the corresponding activities (for example maintenance of the MS).					
Missions							
Personnel							
Consumables							
Munitions							
Mission Support							
Support							
Management							
Maintenance							
Corrective Maintenance							
Personnel							
Means							
Consumables							
Services							
Preventive Maintenance							
Replenishment							
Continuation training							
PHST							
Sustaining Support							
Disposal							

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Annex L – EXAMPLE OF CBS (LIST)

…	
Design & development	
Management	
Main System	
HW	
SW	
Support Elements	
Support equipment	
Data & documentation	
Training equipment	
Investment	
Production	
Management	
Main System	
Support Elements	
Investment (GFI & GFF)	
Deployment	
O&S	
Operation	Operating costs of the main system (MS)
Missions	
Mission Support	
Support	Support of the MS and support elements
Management	
Maintenance	
Main System	
Corrective Maintenance	
Personnel	
Means	
Consumables	
Services	
Preventive Maintenance	
Support elements	
Documentation	
Personnel	
Services	Contracts to update documentation
Support equipment	
Training equipment	
Replenishment	
Continuation training	
PHST	
Sustaining Support	
Disposal	

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